TO KILL A SHIP: THE EVIDENCE OF EUROPEAN NAVAL OPERATIONS DURING WORLD WAR II

by

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CHAPTER I

INTRODUCTION

1. Purpose of paper.

This paper is an attempt to compare the relative effectiveness of various naval weapons used during World War II. This paper is not a definitive history of naval actions during the Second World War; it analyzes the weapons and their effect on the control of the sea. Since limitations and strengths of the weapons employed are important, they have been studied in great detail. Also while attempting to understand the most effective weapon, attention has been given to the proper method of employing the different weapons. One of the problems of this paper is that it has been structured narrowly on the types of weapons used. This causes difficulties when a correlation of the dual effectiveness of weapons is analyzed. For example, the striking of a mine in the English Channel caused Gneisenau to remain in port for repairs, where she was destroyed by an aerial bomb.

For a large part of this paper a statistical method of study has been undertaken in order to derive some significant and meaningful relationships. While in several cases this type of study presents serious difficulties, and does not completely eliminate historical judgments, it provides a realistic and firm foundation on which some interesting correlations have been built. It is hoped this method will be further employed in attempts to eliminate certain myths about naval, and perhaps, all other military weapons.

Throughout this paper only the Atlantic Theater has been studied. This has been done because of limitations of space. Also, in order to better understand

how the weapons were viewed during the periods before and during the war, short segments on naval theory have been included with each chapter. While these studies are not complete the limitations of space required in a Master's Thesis have not allowed for greater detail.

2. Ideas and theories of naval warfare.

In order to provide a general framework for the study of naval theories a short segment has been included in this introductory chapter. Whereas each of the following chapters have sections on the naval theory dealing with that particular weapon, this study is more general and describes the views on naval warfare as a whole.

In the most general sense the arguments between naval writers divided on one question. This question was first brought out before World War I. One of the leading naval theoreticians of the time, Alfred Thayer Mahan, suggested supremacy of one nation over another was caused by sea power. Mahan insisted that certain national characteristics shaped the superiority of one nation's military supremacy on the sea. One of the primary ingredients of sea power was the battle fleet. Mahan's conclusions led to, or at least supported, the rapid construction of large battle fleets by Germany and Britain. Mahan's interpretations of sea power influenced the construction of large warships which became increasingly powerful during the period before World War I. A number of technological improvements made such increases in size and power possible. The very least that can be said of Mahan was that his theories and doctrines supported the naval race that had such disastrous consequences for both Germany and England.

Despite the acceptance of Mahan's theories in England and the United States, and to a lesser extent in Germany, a rival school of naval thought arose on the continent. This school of guerre de course, commonly known by its French name

Jeune Ecole, found its leader in Admiral Theophile Aube. The young school believed that the greatest possibilities of controlling the sea lay in commerce destruction and protection of the coastline. With the development of high speed torpedo boats in the 1880's the doctrines of the young school received a great deal of impetus. The whole argument of the Jeune Ecole became directed to the abilities of small craft to attack the more powerful units of a superior fleet. It was Theodore Ropp's contention that the Jeune Ecole was right but fifty or sixty years too early.[1]

It was not difficult to understand how these two schools came into being. Mahan was writing an answer to the young school in his emphasis that commerce attacks were never successful in defeating a maritime power. Mahan felt that throughout history it had been battle fleets which had decided the course of naval operations. The Jeune Ecole, which was primarily a French theory, attempted to find a method to counteract the superior naval force of Great Britain. Also, the French recognized that if the next war with Germany was like the Franco-Prussian War of 1870, naval power would have very little influence. Therefore what the French needed was a cheap, but successful method of defending their coastlines and destroying any blockading force England might attempt to use. The emphasis on attacking commerce presented England with some serious problems, and during the last war achieved some remarkable successes. The Jeune Ecole faded out because of the failure to recognize the possibilities of the submarine.[2] Nevertheless, the development of ideas of small naval weapons was primarily their contribution to naval theory.

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[1]E. M. Earle, Makers of Modern Strategy: Military Thought from Machiavelli to Hitler, (Princeton: Princeton University Press, 1943), p. 447.

[2]Ibid., p. 453.

Given the division of emphasis on the size of weapons it was possible to study some of the controversies during the period between the wars. The First World War seemed to prove to many writers the extreme vulnerability of battleships. This was caused partially because of the failure to develop new theories to meet the changed situation. Mahan was accepted in Germany and England up until the 1914 War with little question. The major naval battle of World War I, Jutland (May 31-1 June, 1916), was practically the ideal type of battle which, according to Mahan, could gain command of the sea. In this battle the German fleet was unable either to reach the Atlantic or defeat a large enough portion of the British fleet to gain superiority. The British at Jutland suffered heavier losses and while able to keep the German fleet in the North Sea, were unable to destroy it. Jutland seemed to show that armament had surpassed armor and naval leaders began to wonder about the future possibilities of battleships. The British fleet on the evening of May 31, 1916, had witnessed the rapid destruction of three of their newest battle-cruisers by major caliber shells. Various writers on naval tactics noticed that no matter how powerful a battleship was built an opponent could always build one more powerful. This belief while seemingly an answer to battleships' vulnerability was nothing of the sort. Throughout recent history one capital ship has been able to destroy another and this has been their prime usefulness. It was more important to discover if the battleship could be destroyed easier by another type of weapon.

There were serious doubts during the period between the wars whether the battleship could accept punishment from other means of attack. Certain advocates of airpower felt that whenever the battleship came under the cover of an opponent's air force, it would be easily destroyed. Probably the most famous of these authors was the American general, Billy Mitchell. His belief in the destructibility

of battleships was based primarily on a number of tests conducted after World War I. Battleships which had been anchored and were taking no defensive action were attacked by bombing aircraft and sunk. These tests, which did not accurately depict the method of destroying a battleship, were used as the basis for an argument against battleships. Several naval officers were led to agree with Mitchell's view. Sir Percy Scott, who had been the father of modern naval gunnery, joined forces with the advocates of air power and expressed his view that battleships were useless. While aircraft were very powerful weapons, it seems that 1920 was too early to fruitfully predict their usefulness in war. A number of operations during the Second World War showed the power of aircraft but some actions showed that the traditional battleship was still useful.[1]

Added to the question of the vulnerability of the battleship because of aircraft was the question of their value in the day of strategic air attack. Several leading theoreticians, both naval and military, predicted that the navy in general, and the battleship in particular, were no longer useful. Some writers were predicting that countries would be destroyed in the first few attacks by aircraft before the navy could exert its influence. While admittedly such military leaders as Lord Trenchard felt that it would be a long while before the airforce could deliver a crushing attack others, such as Fuller, were predicting just such an event.[2]

In both of these predictions concerning air power it seemed to be a return to the beliefs of the Jeune Ecole. A smaller and less expensive weapon would be

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[1]Robin Higham, Armed Forces in Peacetime, 1918-1939, (Hamden, Connecticut: Archon Books, 1962), p. 113-4.

[2]Robin Higham, The Military Intellectuals in Britain, 1918-1939, (New Brunswick, New Jersey: Rutgers University Press, 1966), p. 69. See for the threat of strategic bombardment Elenor Eddy "Britain and the Fear of Aerial Bombardment, 1935-1939," Aerospace Historian, Vol. XIII, no. 4, Winter, 1966, p. 177-184.

able to destroy or neutralize the power of a superior naval force. This emphasis on aircraft limited the scope of the thinking to solely this means of attack.

The naval limitation treaties seemed to give a just basis for the judgment on the distrust of battleships. The first of these conferences limited the construction of ships to 10,000 tons and mounting guns to no larger than 8-inches.[1] Since the Washington Naval Treaty applied only to capital ships it was necessary to call a later conference at London in 1930 to further restrict the naval building programs of various nations. The success of these naval limitation treaties were limited by each participant's desires. Also, they attempted to limit armaments without first settling political questions.

Adding to the problems of the navy was a misconception by the naval powers as to the nature of the next war. Britain seemed to have expected the support of France during the next European war. It was hoped that with the support of France any possible enemy in Europe could have been contained and perhaps defeated. Since France suddenly collapsed nearly the whole of continental Europe fell into Germany's hands. This sudden failure of France rearranged Germany's strategical situation and made it extremely difficult for British forces to actually come in contact with a significant portion of the German Army. Until the invasion of Russia there was no continental opponent which could combat the German armies.

German leaders on the other hand expected the war to be short. After the Fall of France, Hitler seemed to have expected Britain either to surrender or at least come to a settlement. While perhaps Germany had logic on its side they misinterpreted England's determination to continue the struggle. Because Hitler had predicted that the war would be short they had spent little effort on the construction of a navy. When the war started in 1939 the German U-boat arm was

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[1]Raymond O'Connor, Perilous Equilibrium: United States and the London Naval Conference, (Lawrence, Kansas: University of Kansas Press, 1962), p. 11.

equal in number to the British submarine force, but Germany's surface fleet could not seriously challenge the Royal Navy. Had a large number of submarines been available at the first of the war Germany might have been able to defeat England before they had time to develop sufficient countermeasures.

The naval leaders in Britain seemed to be only concerned with the easier problems of naval development during the period between the wars. Admiral Sir Herbert Richmond's concern was not the German submarines but the surface craft. He proposed the development of a large number of small cruisers to protect the shipping lanes. Such a plan ignored two of the major weapons of the small German naval arsenal. The first of these was the pocket-battleship. Richmond's cruisers would have been easily destroyed by the superior armament of the radically new German warships. Totally ignored were submarines and their ability to destroy commerce. The ignoring of such weapons of naval warfare had serious consequences later in the Second World War.

The errors of naval thinking during the period between the wars had a great deal to do with the failures during the war. It was not until 1943 that the Allies began to achieve a large measure of success against the German submarine campaign. If the correct preparation had been available before the war such a situation might have arrived at the very beginning. So far through this discussion several weapons have been ignored. These weapons were in large part ignored by naval theoreticians during the period between the wars. Among these weapons were mines. In the index to the Journal of the Royal United Service Institution there were only six articles mentioning mines.[1] Such a lack of study and misapplication of theories of naval warfare had very important effects during the course of the Second World War.

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[1]Robin Higham (ed.), A Consolidated Author and Subject Index to the Journal of the Royal United Service Institute, (Ann Harbor Michigan: University Microfilms, Inc., 1964), p. 301.

Map I-1 Atlantic Theater

The area bordered by the dark line indicates the regions studied by this paper.

The Lincoln Library of Essential Information, Buffalo, New York: The Frontier Press Comp., 1966, p. 656 C.

3. Definition of terms.

As already mentioned this paper only covers the Atlantic Theater. The Atlantic Theater has been defined as that area of the world's oceans that lies between the eastern shores of North and South America and the western shores of Europe and Africa. The included areas are: North and South Atlantic, Mediterranean Sea, Baltic Sea, Barents Sea, White Sea, North Sea, Irish Sea, Gulf of Mexico, Caribbean Sea, large rivers, and finally ports which were available for ocean going vessels. For an easier description see map I-1 which has been reproduced on the preceding page.

Shallow water was that part of the ocean that lay in areas where the water was less than 100 fathoms or 600 feet deep. Also, the term shallow water has been expanded to mean that part of the ocean that was within forty miles of a major land mass. Major land mass in this sense meant one large enough to support either an air base or a harbor which could take oceangoing ships. The term "shallow water" is often interchangeable with "narrow seas." Narrow seas usually referred to areas of operation where small boats, such as E-boats, worked and was usually close to shore. In practically all cases the different terms referred to the same area, but in those cases where they differ, special mention has been made.

In this paper tonnage, which was not easy to determine, was limited to two different types; gross tonnage and displacement. Merchant ships used gross tonnage which was one hundred cubic feet of permanently enclosed space per ton. Gross tonnage has nothing whatsoever to do with weight. Warships used displacement tonnage which was the actual weight of the water displaced by the vessel.[1] Small

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[1]E. C. Talbot-Booth, Merchant Ships, (London: The Journal of Commerce and Shipping Telegraph, 1959), p. 14.

vessels throughout this paper mean those ships under 1,600 tons. This only applied to merchant vessels because many powerful warships, notably escorts and submarines, displaced less than 1,600 tons.

Throughout the years the definition of warships has changed and it is best to describe the characteristics of those that have changed the most noticeably. Perhaps one of the most confusing terms was battle-cruiser. This was a vessel of nearly the same size as a battleship but with lighter armor and higher speed. In some accounts the German ships Scharnhorst and Gneisenau were described as battle-cruisers and in others were called battleships. Part of the confusion arose because of the increased speed of battleships during the war. During the First World War battleships seldom exceeded twenty-five knots. During the Second World War it was not uncommon to find thirty knot battleships. Warships in order of decreasing size were: battleships, battle-cruisers, aircraft carriers, cruisers, destroyers, frigates, corvettes, sloops, and torpedo-boats.

Destroyers have undergone great changes in both purpose and size during the eighty years of their existence. Originally torpedo-boat destroyers, their first function was to protect the fleet from torpedo craft. This function has remained, but the torpedo craft has changed. No longer was the primary threat a torpedo-boat but a submarine. During the Second World War destroyers according to class were about 1,500 to 2,200 tons. Frigates, sloops and corvettes were somewhat smaller. Nowadays Mitschner class frigates displace 4,730 tons and the destroyer as a type has practically disappeared.

Aircraft have been arbitrarily divided into five classes: (1) heavy bombers, (2) medium bombers, (3) fighter-bombers, (4) fighters and (5) flying boats or seaplanes. Heavy bombers were four-engined and carried heavy loads for long distances. Medium bombers were usually two-engined and carried lighter loads

for shorter distances, but at higher speeds than heavy bombers. Fighter-bombers were usually single-engined and served the dual role of air defense and bombing attacks. Included in fighter-bombers were dive-bombers which, while seldom useful for air defense were extremely accurate in delivering bombs. Fighters were fast single or double-engined aircraft which did not carry bombs but were used for air defense. Finally, seaplanes because of their size and slowness were used for reconnaissance.

4. Accidents.

Because the ships lost be accidents and marine causes cannot correctly be attributed to enemy action a section discussing them has been included in the introduction. Roskill in his official history of the war noted that the Allies lost some 1,600 vessels and over three million tons of shipping because of causes other than enemy action.[1] While information has been difficult to obtain about the losses of ships because of accidents it seems safe to assume they were caused in large part by the conditions of war: convoy, extinguished navigation aids, use of second rate ships and evasive routing through more hazardous areas, inexperienced crews, fatigue, and others.

The Admiralty listing of ships destroyed by enemy actions included a short section on the loss of ships by marine causes.

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[1]S. W. Roskill, War at Sea, Vol. III, pt. 2, (London: HMSO, 1961), p. 305.

Table I-1. British merchant vessels over 100 gross tons lost by marine causes, 3 September, 1939--2 September, 1945.[1]

CAUSE	NUMBER OF SHIPS	TONNAGE
Foundered or lost in open sea.	238	324,000
Fire or explosion.	202	464,000
Collision.	290	496,000
Wrecked or lost off shore.	659	1,395,000
Total	1,389	2,679,000

There were some differences between the figures which Roskill gave and those which the Admiralty produced but the difference reflects American and other Allied ships which were lost because of marine causes. From the chart it became obvious that most ships had accidents near shore. A number of explanations were available for this phenomenon; more condensed traffic, unmarked shoals and other navigational hazards, and generally more traffic because of the large number of small ships.

The loss of warships required a detailed study. During the Second World War in the Atlantic the British lost one escort carrier, nine destroyers, twenty-seven submarines, and forty MTB's or ML's because of accidents or unknown causes. Only seven of the British submarines were listed as lost because of accidents. The other twenty submarines were listed as being lost by causes unknown.[2] Most

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[1]Great Britain: Admiralty, British and Foreign Merchant Vessels Lost or Damaged by Enemy Action During the Second World War, (London: HMSO, 1947), p. 8. Hereafter referred to as British Merchant Vessels. This table includes both Atlantic and Pacific Theaters but it does give a significant indication of the losses of commerce vessels by marine causes.

[2]Great Britain: Admiralty, Ships of the Royal Navy: Statement of Loss During Second World War, 2d September, 1939--2d September, 1945, (London: HMSO, 1947). Hereafter referred to as Ships of the Royal Navy. This listing compared with H. T. Lenton and J. J. Coledge, Warship Losses of World War II, (Shepperton-on-Thames: Ian Allen), and the war loss sections from Jane's Fighting Ships, (New York: Macmillan Comp.).

of the unknowns in the submarine division were probably lost to mines, but there were no survivers. German submarines had fewer losses because of unknown causes because they carried on extensive radio communications with their bases. Added to the loss of British submarines were two American, which were lost in the Atlantic. The S-36 and the R-12 were lost because of accidents in the Atlantic.[1] The Germans lost 781 submarines during the war in the Atlantic by all causes. Of these submarines 32½ were lost because of accidents of one sort or another.[2] During the Second World War the British and Americans lost 75 submarines by all causes. Thus, 12% of the Allied submarines lost were sunk by accidents. The Germans lost 4.1% of their submarines in the same manner. The different rates of loss for Allied and German vessels were difficult to explain. Two suggestions were made about the difference: (1) less experience in handling the complex craft, and (2) the British spent more time operating in shallow waters.

The loss of a ship by any cause was a grevious loss, especially when every vessel was desperately needed but the losses because of accidents were especially important. Not only were they unnecessary, but next to submarines they were the largest cause of loss during the Second World War. No other method of enemy attack except submarines caused nearly as much tonnage to be lost to the British merchant fleet.

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[1]Naval History Division: Office of the Chief of Naval Operations, United States Submarine Losses World War II, (Washington, D. C.: U. S. Government Printing Office, 1963), p. 16-7 and 50-1.

[2]Great Britain, Admiralty, German, Italian and Japanese U-Boat Casualties During the War: Particulars of Destruction, (London: HMSO, 1946).

CHAPTER II

MINES

1. Mine warfare before World War II.

During the First World War mines played a very vital role in the containment of the High Seas Fleet and the destruction of German submarines. Robert Grant in his detailed study of the German submarine losses during the 1914 War noted on several occasions that the mine was the most effective anti-submarine weapon developed during the war.[1] Minelaying was so important during the war against the Kaiser's Germany that minelayers were accompanied by heavy units of the fleet. This practice led, in part, to one skirmish between the opposing battle fleets, the Battle of Dogger Bank. Grant noted that the most valuable of the mine fields were those across the Straits of Dover. The North Sea, he said, was not sealed during the war to submarine traffic. He attributed the success of the Dover Barrage to the limited area in which mines were planted.[2] An added factor to the success of the barrage may have been the watchfulness which the Allies exercised over the area.

During the period between the wars mines were ignored as weapons of naval warfare. This seemed rather incredible because of the prominent role they had played in the 1914 War. The United States Naval Institute Proceedings has only one article dealing with mines and their counter-measures.[3] This lack of study

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[1]Robert M. Grant, U-Boats Destroyed: The Effect of Anti-Submarine Warfare, 1914-1918, (London: Putnam and Company, 1964), p. 17 and 44.

[2]Ibid., 107-8.

[3]Robert M. Grant, "The Use of Mines Against Submarines," USNIP, Vol. 64, no. 9, September, 1938, p. 1275-1279.

severely limited the different applications of these weapons and it was not realized until the war had started that they had a valuable role to play in commerce destruction.

It has not been possible to document the following considerations but they deserve some attention as explanations for the failure of study to be given to mines. The United States and Great Britain have tended to follow Mahan's dicta which led to the construction of battle fleets. While mines were useful for blockading passages, little thought was given to their employment as offensive weapons. Mine warfare fell more in line with the decrees of the followers of the Jeune Ecole. Most consideration of mines has been directed to their defensive aspects. This was in part due to the failure to develop a sufficient delivery system for offensive mines in the 1914 War. The Germans were correct in developing minelaying submarines, but the successful use of offensive mines had to wait until the construction of adequate aircraft. The use of mines as an offensive, as well as defensive weapon, was one of the striking changes of the Second World War.

2. The nature of mines.

Mines were generally grouped into two different classes; independent and controlled. Controlled mines were used in nearly every case as defensive weapons. They were either fired or rendered harmless by a shore station. Their major advantage was that they could differentiate between friendly and enemy ships. Little or no use was made of this type of mine during the Second World War.

The independent mines were of three different types: moored, ground and moving. The moored mine was held in position by a cable or wire which was attached to a heavy weight which rested on the bottom of the ocean and maintained the position of the mine. This type of mine was fired either by being struck by

passing ships or by being influenced by ships which did not strike it but passed near it. Magnetic mines were detonated by the change in the earth's magnetic field caused by the passing of a steel ship. Acoustic mines were detonated by the noise of a ship's propellers. Pressure mines were detonated by the increase of water pressure caused by a large vessel passing near them. Any of these types of mines could be equipped with a counter which counted the number of ships that passed it. This device was an anti-sweeping device which would not allow the mine to detonate until several ships had passed. More will be said about this device in the section on countermeasures.

Ground mines, always of the influence type, rested on the bottom of the sea. Since they did not have the long cables they were necessarily laid in shallower water than morred mines. Admiral Ruge, who commanded part of the German mine sweeping force during the Second World War, placed the limit of twenty-five fathoms on their effective depth.[1] Much beyond this depth, depending on their sensitivity, they would not explode; if they did explode the pressure wave diminished to the point that not much damage was done to the ship passing overhead.

Moving mines, which were seldom used during the war were of three types; drifting, creeping, and oscillating. Drifting mines were allowed to float around the oceans or more often down rivers. Creeping mines were attached to a weight similar to a moored mine, but this weight was not sufficiently heavy to cause them to remain stationary. Oscillating mines were allowed to drift throughout the ocean but due to a clever mechanical invention changed depth constantly and

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[1]Frederich Ruge, Der Seekrieg, Trans. M. G. Saunders, (Annapolis, Maryland: United States Naval Institute, 1957), p. 18.

were always either rising or sinking.[1] Generally moving mines were of the contact type, although some were of the influence type.[2]

3. The explosive nature of various mines.

The effect of mines on ships when they detonated differed greatly. Contact mines since they actually touched the side of the ship were more likely to destroy the underwater integrity of the vessel and cause it to sink. Ground mines, on the other hand, since they sent out pressure waves tended not to sink the more protected vessels but caused internal damage. This internal damage included throwing motors off their mounts, twisting shafts, and cracking boilers.[3] One author has expressed his belief that mines laid on the ocean floor were more dangerous. He felt this because since they needed no positive buoyancy they could carry more explosives.[4] This was of course the case, but the added explosive power of a ground mine was countered by the nearness established by contact mines. It was not added explosive force that made ground mines more dangerous, but increased radius of detonation, increased difficulty of sweeping, and increased efficiency of delivery systems.

The internal damage caused by ground mines was demonstrated by the detonation of mines during the Channel dash of Scharnhorst and Gneisenau. On this

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[1]The effectiveness of this type of mine was restricted. Ships passing through the water created a wake which washed them to one side.

[2]Large parts of this section were derived from a study of the nature of mines by J. S. Cowie, Mines, Minelayers, and Minelaying, (London: Oxford University Press, 1949), hereafter cited as Cowie, Mines. This entire section for the most part has been a condensation of Cowie's study on the nature of mines, but for simplicity's sake this foot note is the only citation.

[3]Ruge, Der Seekrieg, p. 18.

[4]A. D. Van Nostrand, "Minesweeping," USNIP, Vol. 72, no. 4, April 1946, p. 507.

occasion (12 February, 1942) Gneisenau detonated a magnotic mine off the port side in the vicinity of the main after battery. The hull suffered small dents and individual tears along the seams. Scharnhorst detonated two mines; the first caused little damage but the second was somewhat more serious. It exploded off the starboard side and the ship took on more than 1,200 tons of water. Damage was suffered by the fuel pumps, electric installations as well as machinery. Also the main and secondary armaments were partially jammed but soon repaired. In both cases the damage to Scharnhorst and Gneisenau was not great enough to impare permanently their fighting capacity. The battle-cruisers were forced to undergo repairs where Gneisenau was destroyed by an aerial bomb.[1]

The greatest disadvantage of mines was once laid they had no respect for the nationality of the vessel they sunk. With the exception of controlled mines they would just as rapidly sink a ship of the country that laid them as an opponent's vessel. Admiral Raeder noted that in order for the invasion of England to be successful in 1940 it was necessary for the German forces to suspend mine-laying activities in the invasion area.[2] These mines were laid to trap British shipping, but would have been just as effective against German invasion shipping.

4. Countermeasures against mines.

Most of the countermeasures against moored mines had been developed during the First World War. Generally speaking they involved the cutting of the cable

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[1]I. M. Korotkin, Battle Damage to Surface Ships During World War II, Trans. U. S. Joint Publications Research Service for the David Taylor Model Basin, (Alexandria, Virginia: Defense Documentation Center for Scientific and Technical Information, 1964), p. 120-125. Hereafter Korotkin, Battle Damage.

[2]Office of Naval Intelligence, Fuehrer Conferences on Matters Dealing with the German Navy, (Washington, D. C.: Office of Naval Intelligence, 1946-7), Vol. I, 1940, Discussion Points for the Report of the Commander in Chief, Navy to the Fuehrer, 20 June, 1940, p. 58. Hereafter Fuehrer Conferences.

which attached the mines to the weight. Once the mine had floated to the surface it was supposed to be harmless, but if it was not it was destroyed by gunfire.

The new developments in influence mines during World War II made serious problems for the minesweeping forces. One of the first new developments that had to be countered was the German magnetic mine. While the British understood the principle of magnetic mines they had to first discover the specific method by which the Germans had produced these mines. In order to accomplish this a mine was recovered and taken apart and analyzed. This simple action was in fact very dangerous and difficult. Once the secrets of the German magnetic mines had been discovered, countermeasures were immediately initiated. These measures were generally of two types. One was the neutralizing of the magnetic force field of the vessel. This generally meant the wrapping of a ship in electric cable which could be turned on to counteract the magnetic force of the ship. This was known as degaussing. The other method was the creation of an artificial magnetic field to detonate the mines safely. This was first done by having shallow-draught ships tow long lengths of cable which electrically detonated the mines.[1] Later Wellingtons were equipped with electro-magnets in order to detonate the magnetic mines. This last method was really only effective in narrow waters where there was little or no chance of missing a mine because of its being outside the magnetic field.[2]

In order to make it more difficult for both magnetic mines and other types of mines to be swept they were equipped with counters and delayed arming devices.

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[1]John Frayn Turner, Service Most Silent: The Navy's Fight Against Enemy Mines, (London: George C. Harrap and Co., Ltd., 1955), Chapter 3.

[2]Air Chief Marshal Sir Philip Joubert de la Ferte, Birds and Fishes: The Story of Coastal Command, (London: Hutchinson and Son, Ltd., 1960), p. 130 and 183.

The counters were made so that the mine would not explode until several ships had passed by. Also, they could not be detonated by artifical fields until a certain number of passes had been made. This made the sweeping problems much greater because it was necessary to sweep several times in order to detonate all the mines. Delayed arming devices did not activate the mine until several days had passed. This caused explosions when no minelaying activity had taken place for several days. These devices were mixed together in order to make it even more difficult to sweep them.

The acoustic mines were detonated or swept by sound. The British first equipped a number of ships with Kongo hammers which produced a sound wave of nearly the same frequency that was needed to detonate these mines.[1] The Americans in the Pacific attempted, unsuccessfully, to detonate acoustic mines with depth charges and sirens.[2] Noticably, these mines were swept by the same method which made them dangerous, sound. Apparently no method during the war was discovered which would stop the noise of a ship passing overhead.

Pressure mines during the war were apparently unsweepable.[3] A number of methods were used but none of these seemed safe. In general they included going either dead slow over the mines in order not to create a pressure wave or sending a stoutly built ship over them with the sole object of trying to destroy them.

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[1]Turner, Service Most Silent, p. 120.

[2]John D. Alden, Flush Decks and Four Pipes, (Annapolis, Maryland: United States Naval Institute, 1965), p. 37.

[3]Roskill, War at Sea, Vol. III, pt. 2, p. 54. In this work Roskill said that pressure mines were at first impossible to sweep but once again a mine was recovered intact. This implies that a satisfactory method of countering them was developed but he never explains this method. A. F. Pugsley, Destroyer Man, (London: Weidenfeld and Nicolson, 1957), p. 167, stated quite explicitly that there was no satisfactory means of sweeping mines.

As sweeping devices were invented by one side, counter measures against swooping were developed by the other. Careful evaluation of photographs of German U-boats entering their bases with minesweepers in the lead showed the British technicians a method to counter the effect of the minesweepers. They developed a mine which would only fire after it had been influenced by a strong magnetic field. The Germans countered by escorting their submarines with two minesweepers. Another was developed which would only fire after it had been influenced by two strong fields. Had it not been for a limitation of space inside the mine the whole force of German minesweepers might have been necessary to escort one submarine.[1]

5. The offensive war with mines.

During the Second World War 76,000 mines were laid by the British armed services; 55,000 by aircraft; 11, 000 by fast minelayers and destroyers; 6,500 by coastal forces; and 3,000 by submarines. In the process of laying mines one fast minelayer, two destroyers, four submarines, and four coastal force vessles and five hundred aircraft were lost. Axis casualties both sunk and damaged according to the vessels laying the mines were:[2]

Surface vessels----------175½
Submarines----------76
Aircraft----------1347

With some mathematical formulae a correlation which showed the relative effectiveness of each type of weapon can be derived. If the number of mines

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[1]Cowie, Mines, p. 159.

[2]Cowie, Mines, p. 164-5. These figures have a number of flaws in them but are the only ones available. It must be assumed that some of the British mines were laid in the Pacific Theater but the larger percentage were laid in the Atlantic Theater. The half a ship lost in the surface vessel class was because one was lost partially due to other weapons.

laid by each method was divided into the number of ships sunk or damaged a figure which showed, in theory, how much of a ship was sunk by each method was derived. The formula looked like the following.

$$\frac{\text{Ships damaged or sunk by mines laid by each type of vessel or craft}}{\text{Mines laid by each type of vessel or craft}} = \text{ships per mine.}$$

With British mines and Axis casualties the ratio of ships per mine turned out to be:

Surface craft----------	.00985
Submarines----------	.02233
Aircraft----------	.02540
Average----------	.02090

When the process was reversed, i.e., dividing the number of mines laid by each type of craft by the number of enemy vessels sunk or damaged, a figure which was probably more realistic was derived and showed how many mines it took by each method to cause an enemy casualty.

$$\frac{\text{Mines laid by each type of craft or vessel}}{\text{Ships damaged or sunk by mines laid by each type of vessel or craft}} = \text{mines per ship.}$$

The ratio of British mines and Axis casualties turned out to be:

Surface craft----------	63.037
Submarines----------	44.776
Aircraft----------	40.831
Average----------	41.484

Either way the ratio was figured, aircraft were in the British case the most effective method of laying mines. Every mine that aircraft laid sank a larger portion of a ship and it took fewer air laid mines to cause an enemy casualty. While further discussion will be made of the various attributes of aircraft they were the most effective method of offensively laying mines.

During the period from June, 1940, to May, 1945, the R.A.F. flew 19,104 sorties on minelaying missions, laid 46,895 mines and lost 519 aircraft. During this period 737 Axis vessels, totaling 704,771 tons were lost to mines. A further 205 ships or 467,676 tons were damaged by mines.[1] This averaged out as follows:

Average tonnage of ships lost----------958.9000 tons
Average tonnage of ships damaged----------2325.2000 tons

Average tonnage sunk per sortie----------36.8900 tons
Average tonnage damaged per sortie----------24.4800 tons

Average tonnage sunk per mine laid----------15.0290 tons
Average tonnage damaged per mine laid----------9.9728 tons

Average tonnage sunk per plane lost--------1357.9000 tons
Average tonnage damaged per plane lost------901.1300 tons

These figures point out some interesting aspects of mine warfare in the Atlantic during the last war. They adequately showed that mines were much better weapons to attack small vessels in hopes of sinking them than larger ones. The larger vessels were more likely to be damaged than sunk as shown by the more than double tonnage for vessels damaged over vessels sunk. But the rest of the figures pointed out that for each mine laid, for each aircraft sortie, and for each aircraft lost the tonnage sunk exceeded the tonnage damaged by a substantial margin. This situation arose partially from the fact that more tonnage was sunk than damaged by air laid mines. During this period the same number of mines were laid, sorties flown and aircraft destroyed for both damaged and sunk vessels. This was because it was impossible to differentiate which planes were lost, or mines exploded and what their exact effect was on the ships causing the detonation.

The British air minelaying offensive when broken down into quarters showed the effectiveness during the different periods of the war. (See tables II-1 and

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[1] Roskill, War at Sea, Vol. I, p. 336 and 511, Vol. II, p. 395, Vol. III, pt. 1, p. 96 and 289, Vol. III, pt. 2, p. 142 and 275.

II-2.) An immediate success occurred during the third quarter of 1940. After this there was a decline until the first quarter of 1942 and this lasted until the third quarter of 1943. From the low point in the last quarter of 1943 there was a gradual rise in enemy tonnage lost because of aerial mines. A sudden increase (up to 137,764 tons lost) marked the last full quarter of the war.

This sudden increase marked the period when the enemy minesweeping effort had broken down completely. At the end of the war fewer mines were being laid than at any other time since the first quarter of 1942, yet more tonnage was sunk by aerial mines than during any other period during the war. The amount of effort necessary to combat a determined minelaying campaign occupied a large portion of the German Navy's effort. Using oil as a common measurement during the three months of November and December, 1941, and January, 1942, the consumption of oil for the U-boat arm was listed as 12,000 tons per month. During this same period the minesweeping force needed 10,000 tons of oil per month.[1] When this was figured out, it became apparent that Germany expended 83.3% as much effort defending themselves from Allied mines as they did attacking Allied ships with submarines. While this percentage figure may not have held true for the entire war it did show that a large effort was spent in combating enemy mines.

Further consideration will be given to the effectiveness of aircraft as minelayers when compared with aircraft on bombing raids and direct attacks at sea. For the moment, aircraft must be considered more effective, in terms of results achieved against losses, in mine warfare than in any other employment.

The airplane's success as a minelayer over other methods of laying mines was due primarily to its mobility. The pilots could take their craft over areas

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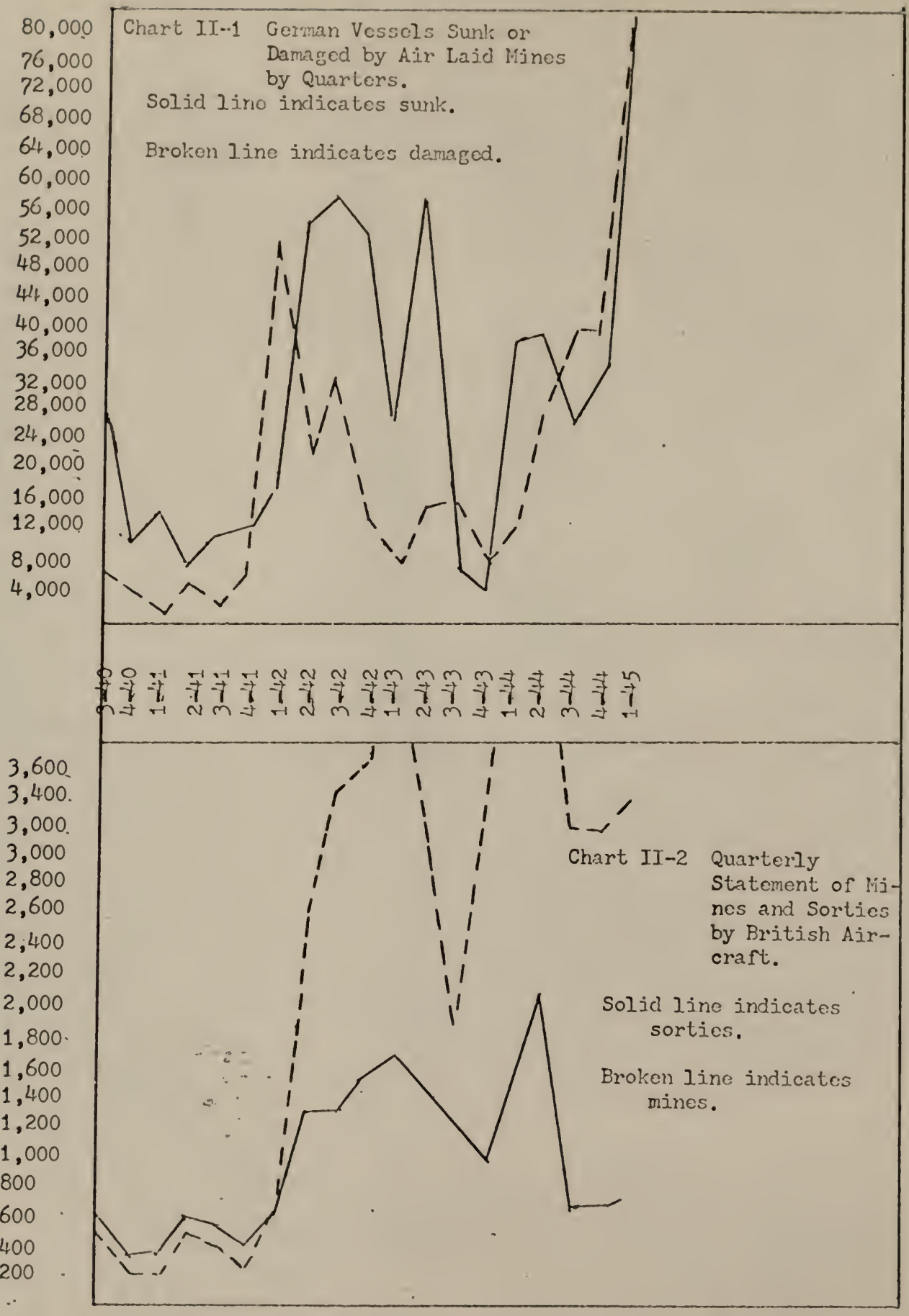
[1] Fuehrer Conferences, Vol. II, 1941, Report of the Commander in Chief, Navy to the Fuehrer, 14 November 1941, Annex 6, Consumption of Fuel Oil, p. 72.


80,000
76,000
72,000
68,000
64,000
60,000
56,000
52,000
48,000
44,000
40,000
36,000
32,000
28,000
24,000
20,000
16,000
12,000
8,000
4,000
Chart II-1 German Vessels Sunk or Damaged by Air Laid Mines by Quarters.
Solid line indicates sunk.
Broken line indicates damaged.
3-40
4-40
1-41
2-41
3-41
4-41
1-42
2-42
3-42
4-42
1-43
2-43
3-43
4-43
1-44
2-44
3-44
4-44
1-45
3,600
3,400
3,000
3,000
2,800
2,600
2,400
2,200
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
Chart II-2 Quarterly Statement of Mines and Sorties by British Aircraft.
Solid line indicates sorties.
Broken line indicates mines.

which were normally closed to surface vessels and submarines. One of these areas was the closed sea, the Baltic. While this was for all intents and purposes a German lake, considerable mention was made in the Fuehrer Conferences and elsewhere that the greatest threat to the security of seagoing vessels in the Baltic was mines.[1]

Aircraft suffered from several disadvantages which other vessels did not. The first of these was noticed by looking at Table II-2. It was not until the first quarter of 1942 that more than one mine was laid per sortie. Surface ships laid perhaps a few hundred mines on each operation.[2] Also, one of the most discussed disadvantages of aircraft as minelayers was their inaccuracy. The British discovered the secret of the German magnetic mines because one fell intact between the high and low water marks on the English coast, also some British mines fell on German soil where they were recovered intact.[3] In January, 1943, a new technique of radar minelaying from 15,000 feet was developed, but some of the mines fell on Sweden, thirty miles from their intended position.[4] Mention was made in the Fuehrer Conferences of using new types of mines in sudden massive campaigns in order to gain the maximum potential before their secrets were discovered.[5] This seemed to confirm the view that the Germans had given up on

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[1]Fuehrer Conferences, 1943, 14 April 1941, Reasons for Increasing the Steel Quota of the Navy, Signed by the Naval Chief of Staff (Miesal), p. 33 and Fuehrer Conferences, 1945, Conference of the Commander in Chief, Navy with the Fuehrer, 20 March 1945, p. 99. Also Sir Charles Webster and Noble Frankland, The Strategic Air Offensive Against Germany, Vol. III, (London: HMSO, 1961), p. 277.

[2]Roskill, War at Sea, Vol. I, p. 579. HMS Adventure (1927) of 6,470 tons could carry 340 mines. The fast minelayers, building in 1939, could carry 156 mines.

[3]Ibid., Vol. III, pt. 2, p. 140.

[4]Ibid., Vol. III, pt. 1, p 288.

[5]Fuehrer Conferences, 1941, Conferences of the Commander in Chief, Navy with the Fuehrer, 22 May 1941, p. 64.

having their new mine devices remain a secret. By building a large stockpile of new mines they could get the most out of them before the British discovered how to counter them.

Submarines, according to the figures on pages 20 and 21, were the next most effective means of delivering mines. The submarine's main weapon during the Second World War was the torpedo but it did achieve some success with mines. Among the submarine's advantages was greater accuracy laying mines than aircraft. Also, submarines went where ships went and it could logically be expected that more ships would follow.[1] This meant that aircraft sometimes laid their mines in water through which ships could not pass. Submarines, on the other hand, seldom, if ever, laid their mines in an area where other ships could not go. The submarine's ability to plant mines and leave the area unnoticed meant that until an enemy vessel detonated one of the mines no counter measures, such as sweeping, took place.[2] The commanding admiral of the German submarine force acknowledged that the submarine's main weapon was the torpedo, but due to changing circumstances mines could at times prove more profitable. He was considering, when he made this statement, the traffic off the American coast. While the heavy unprotected traffic continued it was best to equip submarines with torpedoes. Later when the traffic was thinner and more heavily protected the submarines going to the American coast should have been equipped with mines.[3] Admirals Doenitz and Ruge disagreed about the employment of submarines on minelaying operations.

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[1]Arnold S. Lott, Most Dangerous Sea, (Annapolis, Maryland: United States Naval Institute, 1959), p. 210.

[2]Cowie, Mines, p. 93.

[3]Fuehrer Conferences, 1942, Report of the Commanding Admiral, Submarines at the Fuehrer Headquarters, 14 May 1942, in the presence of the Commander in Chief, Navy.

Admiral Ruge stated twice in his book that submarine crews were never predisposed to minelaying operations. Admiral Doenitz in his memoirs noted that while he was commanding the U-boat arm he argued for increased numbers of minelaying submarines.[1]

Offensive minelaying operations were generally less critical than defensive mine fields. This does not mean to say that they had less value than defensive fields. What it does mean was that in England's case the primary necessity was the defense of merchant shipping. The attack on German merchant shipping while contributing greatly to the total war effort was not absolutely necessary for England to achieve a victory. Germany on the other hand was not as dependent on merchant shipping but England could have been defeated without an offensive mine attack.

6. The defensive war with mines.

Mines in offensive actions were a relatively new development of the Second World War. During the 1914 War they had been used in this manner but never as extensively as in World War II. During the war with Hitler mines played a diminished role as defensive weapons.

Part of this change in role was due to the rearrangement of geography. Admiral Wegener, one of the few German naval theorists of the period before the Second World War, had predicted the value of conquering Norway.[2] The conquest of the Scandinavian coast along the Atlantic and the Fall of France gave Germany a position which was extremely difficult to blockade with mines.

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[1]Ruge, Der Seekrieg, p. 67 and 255. Karl Doenitz, Ten Years and Twenty Days, Trans. R. H. Stevens, (London: Weidenfeld and Nicolson, Ltd., 1959), p. 43-4.

[2]Lt. Cmdr. Peter K. Kemp, Key to Victory: The Trumph of British Sea Power, in World War II. (Boston: Little Brown and Comp., 1957), p. 59. Cited from Vice-Admiral W. Wegner, Die Seestrategie des Weltkriegs, p. 49.

In order to protect British shipping around the British Isles an area dangerous due to mines was declared by the Admiralty on November 27, 1939. This area was roughly from Newcastle to Great Yarmouth. On December 23, an additional area was declared from Rattray Head to the Thames. In both of these areas mines were laid to deter German forces from making raids on the east coast and against shipping which was normally heavy in these waters. Also, false mines, ones which looked similar to regular mines but were impotent, were sown instead of real mines. This was done to convince the intelligence services that mines were in fact being laid, but when the time came to lay larger operative fields these mines would not have to be swept.[1] John Turner described the early British minefields as "propaganda publications."[2]

After the Fall of France plans to lay large mine barriers across the North Sea and the Straits of Dover were discontinued because the German Army now occupied territory which had been one end of the earlier mine barrage. It was now impractical to lay such a field because German naval and merchant vessels could have escaped to the Atlantic from Norway, north of the Orkneys, or from France and the Bay of Biscay. Also, Hitler's Empire did not possess a battle-fleet similar to the High Seas Fleet and it would have been impractical to plant such a tremendous number of mines (71,126) to stop the small flow of commerce that crept in or the few warships that Germany possessed.[3] The World War I minefields were orginally meant to stop submarines but they were able to escape through other areas in 1940.

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[1]Cowie, Mines, p. 130.

[2]Turner, Service Most Silent, p. 13.

[3]Cowie, Mines, p. 70.

The depth at which mines could be used effectively was the cause of considerable controversy. Defensive fields were usually moored mines and Admiral Ruge in his history of the German Navy stated that moored mines could only be used in depths of water up to two hundred fathoms, 1,200 feet.[1] Yet at the outbreak of the war England possessed mines which could be moored in 6,000 feet of water and remain 303 feet below the surface.[2] A minefield was in fact laid across the Iceland-Faroes Passage where the water was in some places considerably deeper than 1,200 feet. It seemed that the limitation of 1,200 feet for the use of moored mines was not accurate but at depths which greatly exceeded this limit--or for that matter, approached it--they lost a great deal of their effectiveness.

The largest and most extensive of the defensive minefields laid during the war was the Iceland-Faroes barrier. During the war 6,100 mines were laid in this area in an effort to curtail Germany transits through this area.[3] Roskill twice noted the ineffectiveness of this barrier. It sank only one U-boat and no surface vessels but was a source of constant trouble to the Allies.[4] The passage around the northern end of England was one of the primary escape routes of German vessels but they passed through the Denmark Strait instead of the Iceland-Faroes Passage.

Part of the problem of large defensive minefields was that the mathematical odds of a ship striking a mine were not certain. Cowie developed formulae to assess the chances. If a mine field was one lane wide and the ship approached

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[1]Ruge, Der Seekrieg, p. 18.

[2]Cowie, Mines, p. 70.

[3]Roskill, War at Sea, Vol. I, p. 390.

[4]Ibid., Vol. I, p. 268, Vol. II, p. 255.

the field at right angles, the percentage chance of a ship escaping unharmed shown by the following formula: $\frac{S-W}{S} \times 100$. In this case "S" was the spacin between mines and "W" was the width of the target at the depth the mines were laid. In order to figure the chance of damage to the ship the figures derive from the formula were subtracted from a hundred. For example, suppose the sh had a fifty foot beam and there was one hundred and fifty feet between mines. $\frac{150-50}{150} \times 100 = 66.67\%$ chance of escape. Subtracting this from 100 gives a 33 chance of destruction. In actuality the odds of destruction were somewhat gr because of the width of the mines themselves. If there were more than one la of mines the formula was $\frac{(s-w)^n}{(s)} \times 100$ where "N" equals the number of lines. the same figures as before and assuming two lanes the chances of destruction somewhat greater. $\frac{(150-50)^2}{(150)} \times 100 = 44.44\%$ of escape or a 55.56% chance of d struction. If there were three lanes the percentage of escape unharmed was 29.63%; if there were four lanes the percentage of escape was 19.75%. Obviou until the mines became closer together than the width of the ships there was ways some chance that a vessel would be able to pass through unharmed. The d tance between mines was determined by two things: (1) the number of mines av able in comparison with the distance which was to be covered, and (2) if an u limited number of mines were available the distance was determined by how far the detonation of one would cause the explosion of its neighbor. If the expl of one would have caused the detonation of its neighbor at distances greater the beam of passing ships, then the only method insuring the destruction of a passing vessel was to insure the destruction of the whole field.

The figures presented above assumed a perfectly ordered minefield with n drifting and each mine keeping its position in relation to its neighbor. If the current was perfectly steady the relative distance between mines would ha

remained the same but it was doubtful if the mines kept such an orderly arrangement. Moored mines drifted in tides and currents relative to the depth of water in which they were moored. Also, as they drifted the pull of the cable drug them downwards until they were not at the determined depth to strike the bottom of a passing vessel.

The Iceland-Faroes Passage was 283 miles across. Assuming one line of mines perfectly placed, the mines were 216 feet apart.[1] Using the largest of the German warships, Bismark and Tirpitz, which had beams of 118 feet, the chances of getting caught in a passage through this minefield were:[2]

$$\frac{216-118}{216} \times 100 = 45.37\%$$

With a threat of little more than fifty-fifty of getting caught when this field was in perfect order, the field was sufficient to deter the sailing of German warships through this passage. Bismark during its sortie into the Atlantic chose Denmark Strait and the threat of mines may have contributed to this decision.

The other defensive field which compared to the barriers established by the British during the First World War was one which crossed the Straits of Dover. This field had more success than its northern counterpart. It sank two submarines, U-12 and U-40.[3] Both of these losses occurred in October, 1939. After the

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[1]This has a number of assumptions in it. First the width of the minefield has been limited to 250 miles. This was done on the assumption that some areas were not covered because of their proximity to English held territory. The figure of 250 miles has been translated into feet and divided by 6100 which was the figure of the number of mines derived from Roskill (See page 28). Also, it assumed that the mines were laid at the correct depth to catch the German warships at their maximum width and the ships approached at right angles.

[2]Thaddeus V. Tuleja, Twilight of the Sea Gods, (New York: W. W. Norton and Co., 1958), p. 149.

[3]Admiralty, German, Italian, and Japanese Submarine Losses.

successful German invasion of Norway, Low Countries, and France this field lost its usefulness because it was outflanked. The German submarines no longer attempted this passage because they could reach more satisfactory basses than those in the Baltic; those along the French and Norwegian coast. The German battle-cruisers during their dash up the English Channel in February, 1942, were not detered or stopped by the minefield placed across the Straits of Dover. Two reasons probably played a large part in the decision to attempt a passage through the traditionally British dominated channel. The first of these was the destruction of Bismark. The German leadership after having witnessed the destruction of their most powerful warship by the overwhelming British sea power was more reluctant to commit a large portion of their remaining surface force to the threat of the British surface fleet. The second consideration was the minefield could be swept in such a narrow area to give the battle-cruisers a safe passage. The laying of defensive minefields close to enemy held territory gave the Germans the ability to sweep out narrow channels for passage of ships.

Cmdr. Lott has pointed out other objections to defensive minefields. Before the 1939 War began the idea of protective minefields in American waters raised horrified objections, even among naval officers. It was feared that these mines would break loose and menace American shipping, but this was for the most part unfounded because moored mines were equipped with a safety device which rendered them inactive once the tension was taken off the cable. What was probably a more dangerous threat to American shipping was that large defensive fields made obstacles around which coastal traffic had to pass. German submarine captains, hunting for the heaviest shipping concentrations were not above taking advantage of this and concentrating their attacks along its edge.[1]

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[1]Lott, Most Dangerous Sea, p. 45-6.

The use of defensive fields was also taken advantage of by the British. Marc' Bragadin noted that the minefields laid between Italy and Tunisia restricted traffic to narrow fixed lanes which made the shipping more vulnerable to attack by submarines and aircraft.[1] Donald Macintyre in his study of the naval campaigns of the Mediterranean said that the British countered the Italian protective minefields by having the fast minelayers Abdiel and Welshman lay transverse lanes across the protected path.[2] It was difficult to determine, but the laying of a mine protected lane from Italy to Tunisia may have been a mistake on the part of the Italian Navy. The largest percentage of Italian ships were lost because of air attacks. Of the Italian warships sunk 34% were lost because of air attacks. Of the Italian merchant ships sunk 37% were sunk by aircraft.[3] How much the mines made attacks on these ships easier was undertermined but the incorrect application of mines should not be ignored.

7. The effect of mines during the Second World War.

The sinking of vessels was only part of the story of mine warfare in that, while indirect effects may not have been quite as spectacular, they were, in many respects, as important. As offensive mining campaign required the enemy to spend large numbers of ships and men to combat it. Also, such a campaign forced traffic from shallow waters and places where it would normally have been safe into areas where it could be more easily attacked by other types of weapons. While less than five percent of the German submarines lost during the war were

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[1] M. A. Bragadin, "Mediterranean Convoys in World War II," USNIP, February 1950, Vol. 76, no. 2, p. 155.

[2] Donald Macintyre, The Battle for the Mediterranean, (London: B. T. Batsford, Ltd., 1964), p. 202.

[3] Marc' Bragadin, Italian Navy in World War II, Trans. Gale Hoffman, (Annapolis, Maryland: United States Naval Institute, 1957), p. 360 and 366.

because of mines, dislocation, and loss of time was one of the contributing factors to the victory over submarines.[1] Finally, mines stopped traffic until sweeping or other countermeasures had been completed.[2] In April, 1944, eleven mines laid in the Kiel Canal were estimated to have caused the virtual loss to the Axis powers of one million metric tons of cargo even though not one ship was lost because of these mines.[3] Also, during the first three months of the war the loss and confusion caused by Germany's laying of four hundred and seventy mines was, according to Roskill, totally out of proportion to the number of mines laid. By the middle of November, 1939, only one of the three deep water channels in the Thames was open to traffic.[4]

The effect of mine warfare on the U-boat war was difficult to objectively examine. Considerable note has been made of the effect of the mining campaign on the U-boat war in both the War at Sea and the Strategic Air Offensive. The latter particularly noted that the U-boat training grounds were closed for several periods because of the danger of mines in the Baltic during the latter part of 1944. Webster and Frankland stated that no exact interpretation of how great

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[1]Derived from Admiralty: German, Italian and Japanese U-Boat Casualties During the War. For the dislocation of the submarine effort see Roskill, War at Sea. Vol. III, pt. 2, p. 140.

[2]Buford Rowland and William Boyd, U. S. Navy Bureau of Ordnance in World War II, (Washington, D. C.: U. S. Government Printing Office, 1953), p. 158.

[3]Cowie, Mines, p. 189.

[4]Roskill, War at Sea, Vol. III, pt. 2, p. 100 and 102.

this effect was can be made but speculated that perhaps as many as twenty of the new Type XXI submarines were never operational because of the mining of the Baltic.[1]

The effect of the mining campaign on the U-boat war can be more objectively examined in terms of submarines sunk. During the Second World War thirty-eight German and Italian submarines were either known to have been, or presumed to have been mined. This figure was only six more than the number of boats lost because of accidents on the part of the crews. The losses, even if it was accepted that all the "presumed mined" vessels did in fact meet their end because of mines, amounted to a little more than four per cent of the total losses of German and Italian submarines.[2] While any submarine lost contributed to the defeat of the German U-boats, mines were not the major factor aiding this end. Roskill took the view that throughout the war the contributions of mines to the defeat of the U-boat was so much less than other methods--surface craft and air attacks--that they seemed insignificant.[3] The Axis minelaying effort against British submarines was more successful. Of the seventy-five British and American submarines lost during the war, twenty-two or twenty-nine per cent were sunk

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[1]Roskill, War at Sea, Vol. III, pt. 2, p. 140 and Webster and Frankland Strategic Air Offensive Against Germany, Vol. III, p. 277. In a footnote Webster and Frankland attributed the information concerning the closing of the U-boat training ground to Captain Peyton-Ward, R. N., who examined the papers of Admiral Freideberg who commanded the U-boat trials and training establishment. No mention of the cessation, which surely had far reaching effects on the U-boat campaign in the last days of Hitler's Germany, was made in the Fuehrer Conferences. While the papers of Admiral Fiedeberg have not been seen by this author it seemed that such an important matter would have been brought to Hitler's attention.

[2]Admiralty, German, Italian and Japanese U-Boat Casualties During the War.

[3]Roskill, War at Sea, Vol. II, p. 394.

by mines.[1] The explanation for the difference in losses may come from the knowledge that while most of the German losses were in the Atlantic--including such areas as the Arctic, North Sea, and the Bay of Biscay--most British losses were in the Mediterranean (sixteen out of twenty-two). German submarines operated for the most part in mid-ocean where the waters were not mineable and only passed through mineable waters en route to or from their hunting grounds. British submarines, on the other hand, had to proceed in coastal waters to find significant targets for their torpedoes. Nearly all the Mediterranean was so shallow that mining was possible. In the Atlantic the British surface ships effectively controlled the Axis deep water traffic and the submarines were forced to hunt in shallow water for their targets.

The amount of delays and damage suffered indirectly because of mining operations through waters which U-boats had to pass was a contributing factor to the victory by the Allies in the Battle of the Atlantic. Roskill noted that the mining of waters close to shore by aircraft and the mining of waters up to the hundred fathom line by surface vessels caused the U-boats to travel on the surface a long way from the coast. Because they had to travel on the surface they were more vulnerable to other means of attack. Cowie noted this same aspect of mine warfare when he wrote that one of the main purposes of minefields was to make the enemy take a course of action which in normal circumstances he would not have adopted.[2] By noting map II-3 on the following page which shows U-boat losses by air attack during the period January 1942 to May 1943 it became evident that the danger from air attack was not inside the hundred fathom line. Roskill seemed to

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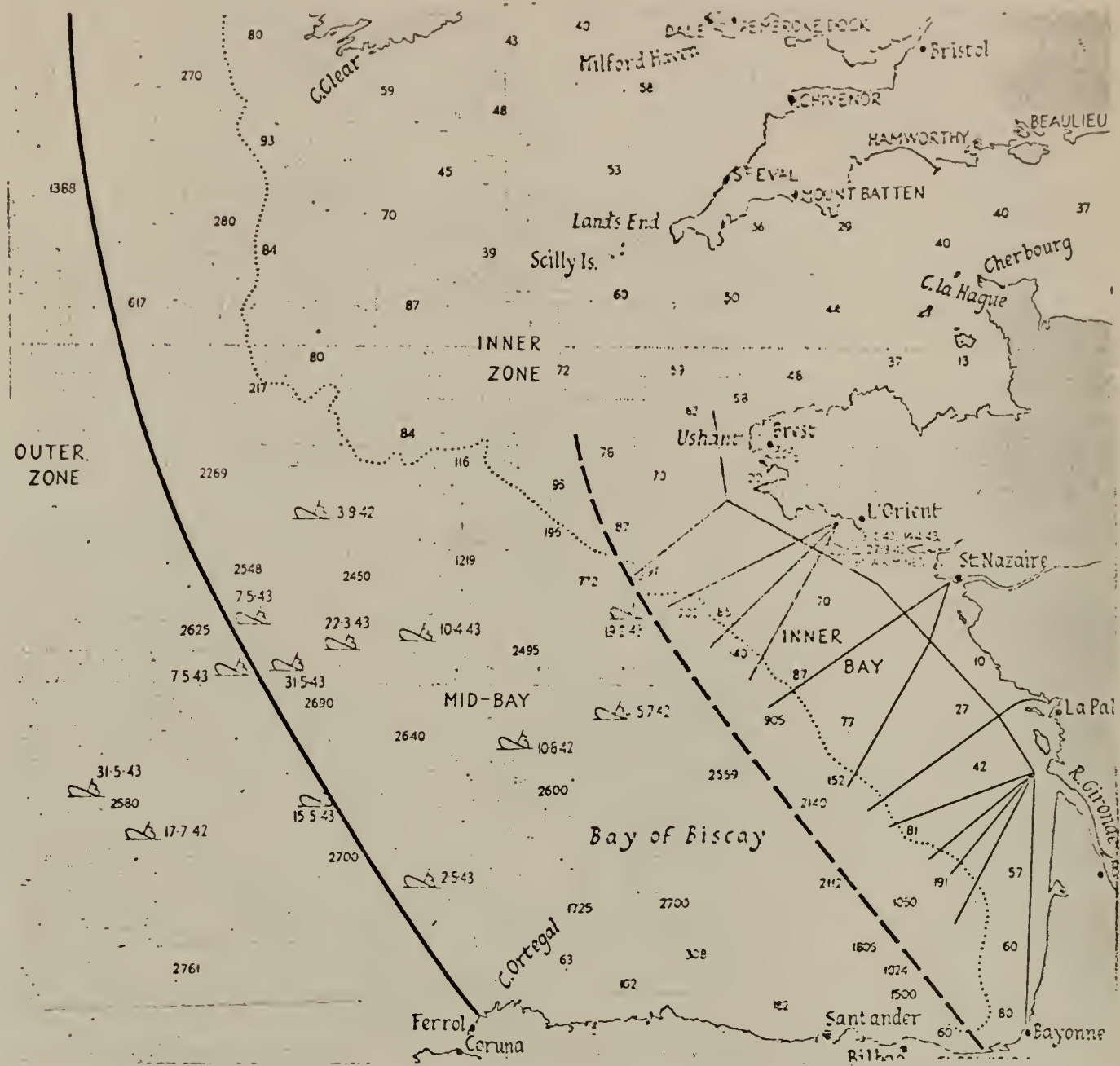
[1]Derived from Admiralty, Ships of the Royal Navy, and Naval History Division: Office of the Chief of Naval Operations, United States Submarine Losses, World War II, (Washington, D. C.: U. S. Government Printing Office, 1963).

[2]Cowie, Mines, p. 82 and Roskill, War at Sea, Vol. II, p. 262.

Map II-3 U-Boats Lost in Transit Through the Bay of Biscay, June 1942-May 1943, Showing the Location of Loss and the Depth of Water in Fathoms.



Roskill, War at Sea, Vol. II, between pages 368-9.

contradict himself because he wrote that the mining operations caused U-boats to remain on the surface and were more vulnerable to air attack, but the map shows that not one submarine was lost during this period in shallow waters.

Table II-3 shows that the British losses of merchant vessels came for the most part during the early part of the war. Table II-1 showed German losses coming during the latter part of the war. During the entire war only two British vessels, totaling 8,597 tons, were sunk by mines laid in deep water. These deep water losses amounted to a very small fraction of the total British losses due to mines.

Part of the explanation of the British losses in the early part of the war and the German losses in a latter was due to the sudden, though not altogether unexpected, attack using a new influence type mine. The small scale of the German attack with magnetic mines caused dislocations in British traffic which were totally out of proportion to the number of mines laid. Roskill noted that four hundred and seventy mines were laid during the first three months of the war.[1] The mines caused the loss of fifteen ships during the period September-November, 1939. This averaged out that for every thirty-one and a third mines laid, a ship was lost. As already noted in the Allied attack on Axis shipping it took a little more than forty-one mines to cause the loss of an enemy ship. The greater amount of shipping preceding in and out of Allied countries and unpreparedness were certainly factors in the high rate of losses suffered at the beginning of the war. Roskill noted that during November and December, 1939, mines were a more effective weapon than submarines.[2] This was true in the sense that during the period mines sank 82,843 tons of British shipping as compared with submarines sinking

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[1]See page 35.

[2]Roskill, War at Sea, Vol. I, p. 106.

Table II-3 Quarterly Statement of Loss of British Merchant Vessels Over 1,000 Gross Tons, Sunk in Shallow Water.

Derived from British Merchant Vessels.

37,990 tons. But this was only a temporary event. When the figures for the four war months of 1939 were totaled, submarine kills were highest, 151,486 tons to 98,994 tons.[1] Certainly the figures of ships destroyed by submarines were artifically high during the months of September and October, 1939, because the entire force was on war patrol. By the same token, the figures on November and December were artifically low because the submarines during this period were in port refitting, refueling and rearming.

Warships which were inherently different from merchant ships, being neither of the same design nor the same purpose, were not included in the figures for losses of British merchant vessels shown on table II-3. During the entire war only one major warship, the cruiser HMS Neptune of 7,175 toms, was lost to a mine. No battleship, battle-cruiser, or aircraft carrier was lost by the Allies in the Atlantic because of mines. Of the hundred and sixty-four destroyers lost during the war, thirty were sunk because of mines. Eighty-two trawlers out of two hundred and fifty were lost because of mines. Seventy-nine minesweepers and related vessels were lost during the war. Thirty-seven were lost because of mines. The percentages figured out to be:[2]

Destroyers----------18.2%
Trawlers----------32.0%
Minesweepers----------46.8%

It was not suprising that while mines did not sink a majority of minesweepers, they were responsible for more losses than any other method of attack. Also, it should be noted that minecraft were the most vulnerable of the above mentioned types of ships. This was not unusual because the primary job of minesweepers was to hunt out and destroy mines where other ships attempted to avoid them.

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[1]Admiralty, British Merchant Ships.

[2]Admiralty, Ships of the Royal Navy.

Trawlers which had been recruited into the Royal Navy were still basically fishing vessels and were the second most vulnerable type of ship to mines. The actual steel warship had the least to fear from mines.

8. Conclusion.

Mine warfare during the Second World War proved to be a very potent method of destroying commerce. The most effective method of attacking enemy commerce with mines was an offensive campaign where the mines were delivered by aircraft. Defonsive fields achieved some worthwhile purposes during the war but sometimes the enemy was able to take advantage of these fields. Perhaps the most important aspect of mine warfare, which has not been discussed because it was impossible to measure its effect, was psychological. Admiral Pugsley in his book with Donald Macintyre commented that mines were the one fear which the commander of a vessel could never ignore.[1] The constant alert for mines and sudden unexpected destruction certainly caused mental anxiety to the captain and the crew of a ship. How this affected thoir actions and lowered their efficiency was impossible to determine. The mine was a powerful weapon for detering actions of an enemy, destruction of his commerce vessels and causing an undetermined amount of psychological restrictions.

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[1]A. F. Pugsley and Donald Macintyre, Destroyer Man, p. 168.

CHAPTER III

AIRCRAFT

1. Ideas about employing aircraft before the war.

The airplane which first saw use during the First World War was one of the most controversial weapons of the period between the wars. A number of predictions were made by both supporters and opponents of air power. Generally both groups overstated their argument. The air power enthusiasts declared that the Navy's capital ships could be sunk easily by planes. Naval leaders refused to recognize this danger. Both sides of the controversy were right in part and wrong in part. One of the most obvious errors was the failure to forsee the value of aircraft in destroying submarines.

American General Billy Mitchell was a leader of the air power advocates. He based his beliefs on the destruction of an old German dreadnaught Ostfriesland. This warship was attacked with 53 bombs weighing between 250 and 600 pounds. When this first attack failed the ship was again bombarded the following day with five 1,000 pound bombs and seven 2,000 pound bombs. The Ostfriesland sank twenty-one minutes after the first ton bomb fell.[1] Gen. Mitchell suffered disgrace and court martial because of his remarks which offended some members of the establishment.

A number of bombing tests were conducted on battleships. These tests had one thing in common; they were unobjective. Target vessels were usually anchored

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[1] John Philips Cranwell, The Destiny of Sea Power and Its Influence on Land and Air Power, (New York: W. W. Norton and Co., Inc., 1941), p. 113.

unmanned and put up no resistance. These tests neither accurately depicted the aircraft's ability to destroy surface warships nor the battleship's ability to survive aerial attack. During the Second World War no capital ship was sunk in the Atlantic while at sea by air power. The aircraft's ability in attacking warships was not against capital ships but against the smaller warships.

A number of theorists felt that sea power had been supplanted by air power. Members of strategic air forces felt that aerial bombardment could force a country into submission before sea power could exert its long range influence. Duncon Grinnell-Milne in his study of the failure of the German armies to invade England stated that the Luftwaffe was over confident about the effect of air power.[1] He mentioned several times that the German leadership thought that the invasion of England would just be a take-over. According to Grinnell-Milne the only one who correctly appreciated the naval situation was Raeder. The weapons of World War II did not give the air forces the striking power to force a country into surrender.

The development of air forces between the war was marked by a series of controversies about the command of planes over the sea. The Fleet Air Arm did not come into existence until five months before the outbreak of the war. It took actual war experience to convince the Air Ministry of the necessity of placing Coastal Command under the control of the Admiralty.[2] The German leadership had similar problems with a naval air force. Admiral Raeder and Field Marshal Goering had a number of discussions about whose service was to control aircraft which

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[1]Ducan Grinnell-Milne, The Silent Victory, (London: The Bodley Head, 1958), p. 46.

[2]F. H. Hinsley, Command of the Sea: The Naval Side of British History from 1918 to the End of the Second World War, (London: Christophers, 1950), p. 28-9.

operated over the sea. In the end the Luftwaffe was left with sole control of the air forces. This had serious repercusions for the development of German naval air power.[1]

Raymond O'Connor in his study of the naval disarmament controversies attributed their failure in large part to a misconception of air power. He felt that it was a logical assumption that carriers would be the source of controversy, but it was cruisers that caused the most difficulties. According to O'Connor this was because the role of aircraft in relation to sea power was not completely understood. The failure to comprehend the place of air power created an unstable and illusory equilibrium of armaments.[2]

The role of aircraft in the Second World War was sharply divided by the summer of 1943. Before this period they had made a number of stunning successes--the raid on Taranto and the destruction of Bismark--but airplanes had not yet become an everyday influence on sea power. Before 1943 their sole effect was to contribute some brilliant victories. After the summer of 1943 their role was changed to the more important and consistent exertion of force. There were few outstanding victories but the constant application of air power contributed greatly to the victory of the Allied sea power.

During the period before the war considerable discussion took place about the most effective method of employing aircraft in attacks on ships. While torpedo planes were accepted by the Admiralty little or no study was given to the tactical use of this type of air attack. According to Commander Kemp the Admiralty placed its faith in the torpedo because during the First World War it had sunk more

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[1]Office of Naval Intelligence, German Naval Air, 1933 to 1945: A Report Based on Naval Staff Documents, (Washington, D. C.: Office of Naval Intelligence, 1947).

[2]O'Connor, Perilious Equilibrium.

tonnage than all othermeans of attack combined.[1] Had sufficient study been given to the developing tactical oporations with torpedo planes they might have achieved much more than they did. Admiral Raeder thought if sufficiently equipped and trainod torpedo planes had been available at the beginning they might have vitally affected the course of the war. He noted in a conference with Hitler that had a hundred torpedo planes attacked the Royal Navy at the beginning of the war the chances of a German naval success would have been much greater.[2]

The bomber advocates were divided on their opinions of the most effective way to employ bombing aircraft. Some felt that because dive-bombing was so much more accurate than high-level bombing this was the correct method of attacking warships. The problem with dive-bombers was that while more accurate they could not carry the bomb load that the high-level bombers carried. Also, the casualties were much heavier among low-level bombers than high-level. The main advantages of high-level bombing were that the casualtios from anti-aircraft fire were less and the bomb load was considerably greater. Its disadvantage was that it was inaccurate. From 12,000 feet it took a bomb 28 seconds to fall. In this length of time a high speed warship moved nearly a 1,000 feet.[3] With a fast moving, zig-zagging warship under attack the odds of hitting them with a sufficiently heavy bomb to cause their destruction was very slim. Billy Mitchell predicted that the chances of hitting a battleship with aerial bombs was greater

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[1]Lt. Cmdr. P. K. Kemp, Fleet Air Arm, (London: Herbert Jenkins, 1945), p. 99.

[2]Fuehrer Conferences, Vol. II, 1941, Report of the Commander in Chief, Navy to the Fuehrer, 29 December, 1941, p. 95.

[3]Oscar Parkes, British Battleships: "Warrior" to "Vanguard," A History of Design, Construction and Armaments, (London: Seely Service and Co., 1966), p. 659.

than with large caliber guns at 20,000 yards.[1] This statement in itself can be doubted somewhat, but even if it was true, he ignored a number of factors. The aircraft once it had delivered its bomb load had to return to its base before another attack could be made. Battleships corrected their shots until they received straddles. They had the ability to take advantage of their misses while aircraft did not.

During the period before the war the Admiralty and the Air Ministry derived that 43 medium bombers were the nearest equivalent in cost to a battleship.[2] This figure turned out to be a remarkably accurate estimation of the losses which were achieved in the destruction of some battleships. But 43 aircraft did not possess the striking power of one battleship.

This chapter has been arranged slightly different than others in this paper. Aircraft were nearly always used offensively. Therefore the first section deals with their defensive aspects in all forms. After this first section the offensive nature of naval-air war in the Atlantic has been broken down into sections: strategic attacks, attacks on ports, attacks at sea, anti-submarine warfare, and aircraft carriers. Carriers were generally considered capital ships but since they had little striking power other than their aircraft, they have been included in this chapter.

2. Aircraft in defensive war at sea.

Most aircraft used at sea in a defensive manner were defending ships from attack by other aircraft. Seldom was the airplane used strictly as a defensive

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[1]Brigader-General William Mitchell, "America in the Air: The Future of Airplane and Air Ship, Economically and as Factors in National Defense," National Geographic, Vol. 39, no. 4, March, 1921, p. 347.

[2]Parkes, British Battleships, p. 660.

weapon to influence the course of the war at sea. Nearly all the carriers had fighters which they took with them for air defense. Aircraft were used to warn the fleet of approaching forces and attempt to weaken them before they could make an attack. It was hard to see how an airplane could be used to defend the fleet unless it was attacking other aircraft. Of course, planes could attack warships but this verged on offensive action.

The main defense of the fleet against aerial attack was anti-aircraft fire. Nearly all warships carried guns which were suitable for firing at attacking planes. The main armament of the Rodney and Nelson, the only British battleships designed and completed during the period between the wars, had the ability to elevate to 40°. This according to Parkes was done so they could fire at distant aircraft. The maximum range for this type fire was 35,000 yards.[1] More discussion was given to the defensive armament of surface ships in the chapters dealing with them. War experience showed that the defensive armament on warships was insufficient for the needs of driving off aircraft. One of the most notable changes in armament on warships built during the war was the increased use of guns which could deal with attacking aircraft.

3. Strategic air attacks on naval industrial targets.

The most difficult task in measuring the airplane's effectiveness was its ability to destroy the enemy's naval potential through strategic attacks on land targets. In order to measure its effectiveness in the successful conclusion of, for example, the U-boat war, some study has had to be given to determining how much more dangerous Germany's attack would have been had it not been for the destruction of her industrial potential.

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[1]Parkes, British Battleships, p. 657.

A number of decisions were necessary in order to engage in a strategic attack. If the war was going to bo short then strategic attacks would havo been of no value. The value of strategic attacks were long range in nature except in very special circumstances. Also, the loadorship had to mako decisions whether they might loosc the war before their strategic attack had any success. A quick tactical victory might have had long reaching consequences. Had the strategic capabilities of the R.A.F. boen used in attacks on U-boats it might have deterred further usc of submarines to attack British commerce. These considerations were speculative and it was doubtful if thore were any correct answers but they were decisions which the military leadership had to make.

Both Admiral Doenitz and Raeder complained throughout the war of shortages of supplies. Sometimes the shortage ran as much as fifty percent of the needed equipment.[1] The lack of fuel oil was particularly serious to the German war economy. Shortages were evident in December, 1941, before the heavy strategic air attacks on the petroleum industry had started and after Germany had had time to absorb the countries which she had conquered. The German Navy was short of oil in 1941, and even with increased production and facilities during later years, it was still operating with shortages. In March, 1942, Raeder in tho conference with Hitler noted that the allocation of raw materials to the navy was insufficient when compared with the demands placed on it. Further he stated that only thoso vessels nearing completion could be made operational with the materials at hand and if the allotmont was not increased by the end of 1943 all construction of new surface vessels, except one patrol-torpedo boat and two minesweepers per month

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[1] Fuehrer Conferences, 1941, Vol. II, Report of the Commander in Chief, Navy to tho Fuehrer, 12 December, 1941, Annex 4, Tho Fuel and Diesel Situation of the Navy as of December 6, 1941, p. 90.

would cease. Also the production of torpedoes would drop from 480 to 200 during the third quarter of 1942.[1]

All this concern led to the belief that the German naval effort could be contained by concentrated air attacks on German industry. Yet, it remained a fact that the German Navy did not cease its activities because of strategic air attacks on German industry, the production of armaments increased dramatically under the direction of Albert Speer.[2] A number of questions about how much the German industrial machine would have produced had there never been a strategic air attack has not yet been satisfactorily answered. Webster and Frankland listed the losses of German submarines through strategic air attacks. These authors emphasized that their figures were only approximately correct because the assumptions necessary to derive the figures were arbitrary. The British Bombing Survey Unit according to Webster and Frankland were only accurate to plus or minus fifteen submarines.[3] Using figures derived from the B.B.S.U., Webster and Frankland noted that from May, 1943, to April 1945, twenty-nine Type VII, three Type IX, sixty Type XXI, and nineteen Type XXIII or one hundred and eleven U-boats were lost by strategic bombing.[4] During the same period three hundred and thirteen German submarines were lost through various means of air attacks.[5] This figure was artifically high because it included losses caused by aircraft in combination with other means of attack. Since it has been impossible to determine which method of attack contributed the most to the destruction of submarines,

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[1]Fuehrer Conferences, 1942, Report of the Commander in Chief, Navy to the Fuehrer, 12 March, 1942, p. 29.

[2]Webster and Frankland, Strategic Air Offensive Against Germany, II, p. 7.

[3]Ibid., III, p. 276.

[4]Ibid., IV, Appendix 49, p. 524.

[5]Admiralty, German, Italian and Japanese U-Boat Casualties.

aircraft have been credited as the sole attacking weapon. The two figures were added together (313 and 111) and divided into the number of submarines lost because of raids on German industry. The percentage losses of submarines because of strategic attacks was derived as 26 percent. Assuming that the British survey figures were correct, the loss of more than one quarter of the German submarines during this period because of strategic raids certainly justified the effort.

The argument whether bombers were to be employed at sea or strategic attacks was extremely volatile. The Naval Staff felt that large numbers of bombers should have been committed to zones of encounter of submarines. R.A.F. Bomber Command, on the other hand, felt that the level of bomber activity over the Atlantic should have been kept to a minimum. The "industrialists" felt that if the German war production was destroyed the naval power would have been ruined also.[1] This argument was more than just a disagreement about the tactical employment of aircraft. It was a disagreement affecting the very nature of the use of aircraft. This was one of the questions which was first suggested in the introduction to this chapter. It seems that the attacks at sea delivered more results, but this could have been subject to diminishing returns. The dichotomy between the services was not easily settled, and only the building of enough aircraft so that each group could have its way solved the problem.

In connection with the actual effect of strategic attacks on German industry Admiral Doenitz stated in April 1943, that he doubted whether bombing attacks could vitally affect essential industries.[2] Roughly a year later, he reversed

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[1]Webster and Frankland, Strategic Air Offensive Against Germany, Vol. I, p. 327.

[2]Fuehrer Conferences, 1943, Minutes of the Conferences at the Fuehrer Headquarters, 19 August, 1943, Annex I, Conversation with the Fuehrer, 19 August, 1943, p. 126.

himself and said that bombing affected the submarine war because under the system of U-boat prefabrication a shipyard specializing in the producing a particular section might be bombed and all that section of a submarine might be destroyed. Destroying only part, but a vital part, of submarines according to Doenitz might cause the production of thirty or forty submarines to be stopped.[1] This tended to disagree with Webster and Frankland's comments that there were few components in the submarine industry that were "bottlenecks." The British historians further disagreed with Doenitz when they noted that Bomber Command's claim that it could do more attacking ports and construction yards was not substantiated.[2]

The task of assessing the effect of strategic bombing attacks on German industry in relation to the naval war was further complicated by not knowing which planes were lost in contributing to the naval war. If, for example, it could have been accurately determined that thirty percent of the aircraft lost in attacks over Germany and Italy contributed to the successful conclusion of the Battle of the Atlantic a correlation could have been derived which would have shown the rate of losses in attacks on industrial targets as compared with direct attacks at sea. Table III-1 on the following page shows the number of submarines that were operational and those on training and trials. It was obvious that during the period from January 1942 to the end of the war there was no marked decrease in the number of submarines. On the other hand there was no marked increase in the number of submarines once the bombing offensive got started in 1943. Table III-1 also shows the total number of German submarines available during the period from the first of 1942 to the end of the war. During this period

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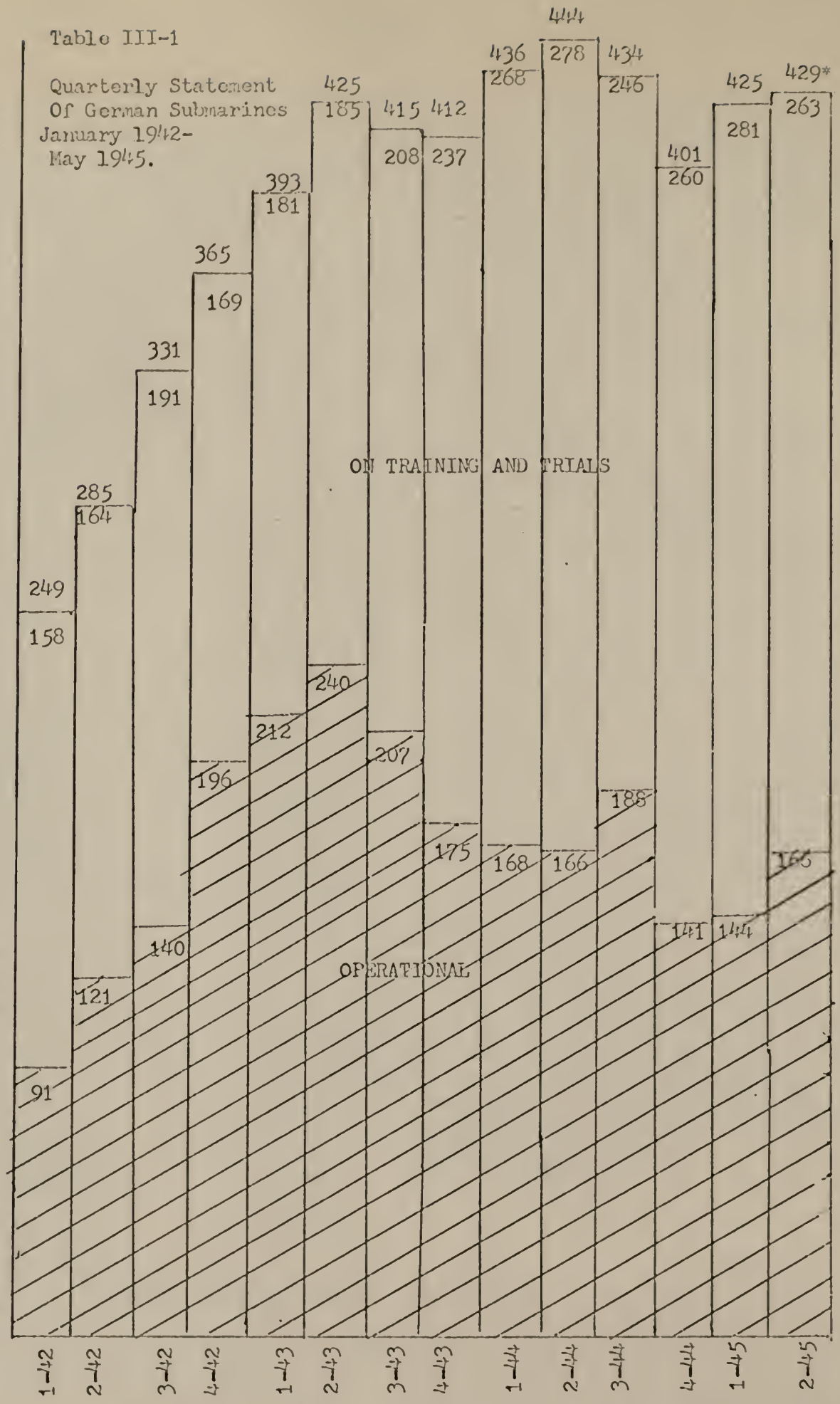
[1] Ibid., Minutes of the Converstion of the Commander in Chief, Navy with the Fuehrer, 4-6 May, 1944, p. 44.

[2] Webster and Frankland, Strategic Air Offensive Against Germany, Vol. I, p. 481 and Vol. II, p. 216.

Table III-1

Quarterly Statement
Of German Submarines
January 1942-
May 1945.



Roskill, War at Sea, Vol. II, p. 425, Vol. III, pt. 1, p. 364, Vol. III, pt. 2, p. 456.

*Estimated.

the total number of U-boats remained relatively steady after 1943 while the number of operational boats declined. This seemed to point out that even with heavier strategic raids on German industry the production of underwater craft was not seriously diminished. Also, it was interesting to note that while the number of operational boats decreased they never reached the low level of 1942. Yet, as it was well known and will later be shown, the U-boats' effectiveness as a naval weapon declined markedly towards the end of the war. This seemed to show that the winning of the Battle of the Atlantic by the Allies was more dependent on better defensive methods and other means of attacking U-boats than strategic attacks on production. One of the advantages of destroying submarines at sea was that the trained crew was either killed or captured; attacks on industry did not remove the crews from the scene.

The problem of the lack of crews became extremely serious to the German submarine force. The lack of crews for the submarines, which were very highly trained, may have been one of the factors which inhibited the offensive action of the German submarine force.

4. Air raids on ports.

Still strategic raids, attacks on ports were significantly different than attacks on industrial machinery. In these attacks some notable successes were scored by the Allies along with some equally notable failures. The most glaring failure of aircraft to sink warships was the running attack on the German battle-cruisers during their stay in Brest. During the short period from 10 December, 1941, to 20 January, 1942, thirty-seven percent of Bomber Command's effort was expended unrewardingly on Scharnhorst and Gneisenau.[1] These raids were almost

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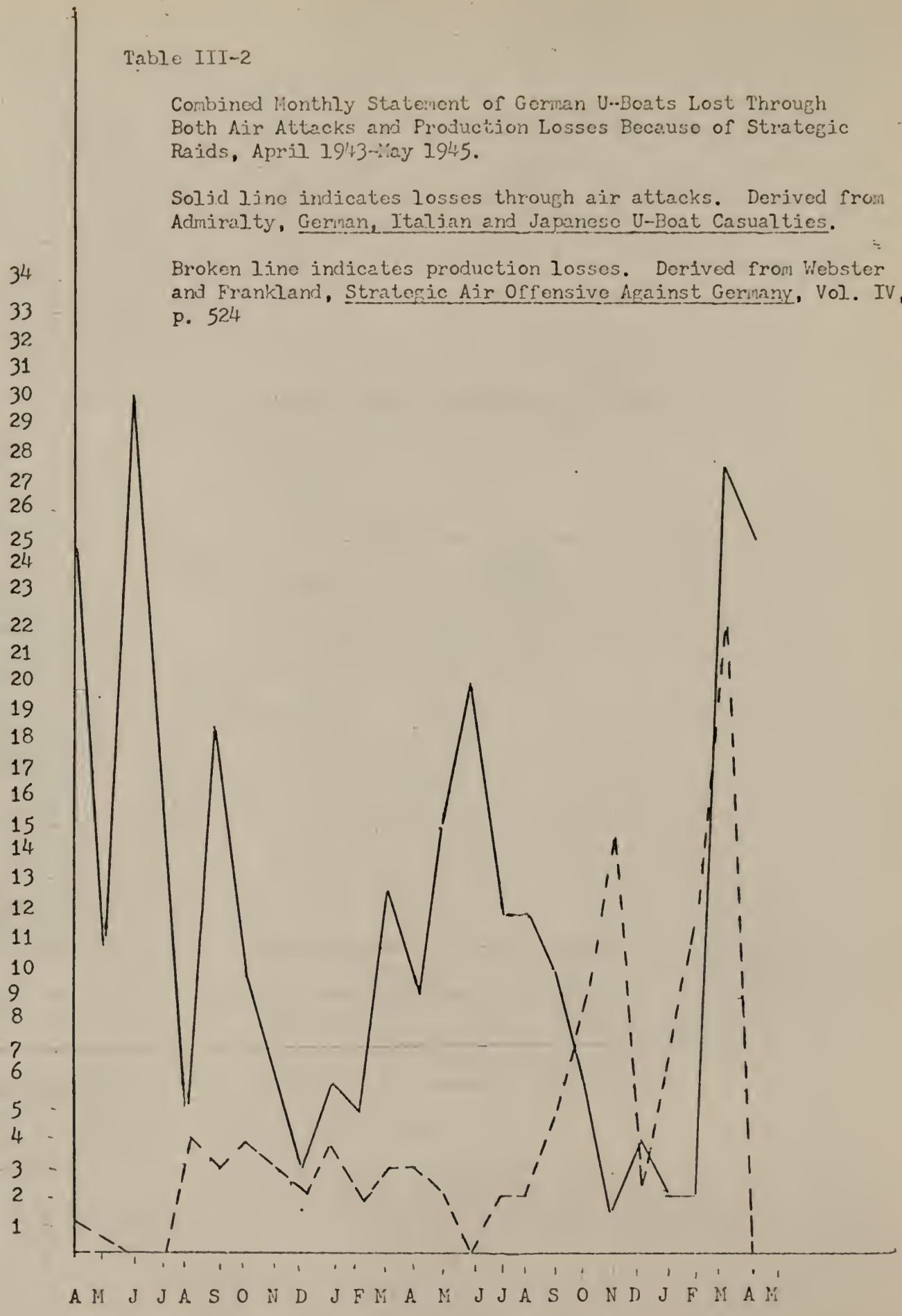
[1]Webster and Frankland, Strategic Air Offensive Against Germany, Vol. I, p. 320.

Table III-2

Combined Monthly Statement of German U-Boats Lost Through Both Air Attacks and Production Losses Because of Strategic Raids, April 1943-May 1945.

Solid line indicates losses through air attacks. Derived from Admiralty, German, Italian and Japanese U-Boat Casualties.

Broken line indicates production losses. Derived from Webster and Frankland, Strategic Air Offensive Against Germany, Vol. IV, p. 524



daily occurrences and yet neither of the ships was sunk or seriously damaged. One of the reasons the dangerous dash up the English Channel was undertaken was because if the ships had remained in Brest it was certain that eventually they were going to be hit and sunk. The attack on Scharnhorst and Gneisenau showed one of the advantages of aircraft which had not been available to previous naval leaders. Mahan in his study on the proper use of an inferior fleet said that its purpose was to remain in port and restrict the offensive operations of an opponent's fleet. The superior naval forces could with aircraft not only blockade the inferior fleet but now had the power to attack and eventually destroy the inferior fleet if it refused to sail.

One of the most famous and important attacks on ships in port was the attack by the Fleet Air Arm on the Italian Navy at Taranto, 11 November, 1940. This attack by twenty-one Swordfish launched from carriers gave capital ship superiority to Admiral Cunningham's force. Previously the Italian fleet in the Mediterranean had been superior in many respects to British Mediterranean fleets. There was a good chance that the Italian force could have sailed and destroyed a portion of the British fleet in the central Mediterranean. The British success at Taranto not only gave the British a temporary material advantage but had far reaching psychological effects. The British seized the initiative from the Italians and it was difficult for the latter to overcome this psychological disadvantage. During this attack by carrier launched planes the Italian battleships Littorio, Duilio and Cavour were put out of action by torpedo hits. This attack left the Italians with only Vittorio and Caesare serviceable.[1] The effect of this daring raid on the Italian home base was far-reaching. It restricted the Italian Navy's

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[1]Macintyre, The Battle of the Mediterranean, p. 36-8.

action throughout the war. Italy, which up until their surrender did not possess any operational aircraft carriers, was restricted in the naval actions which they could perform against British warships in the Mediterranean during the entire war.

The attacks on warships in port were mostly questions of the size of the raids and the accuracy of the bombers. Also, weight and type of bomb made considerable difference in the destruction of ships in port. The heavier the bomb the more destruction it caused, but the chances of hitting a ship were decreased. Armor piercing bombs were needed to penetrate the reinforced deck of a battleship but had little or no mining effect. The decisions on what type of bombs to use were necessitated by the circumstances of the time. If all that was desired was that the warship remained in port until the naval situation became more favorable then a large number of small bombs would do the job. On the other hand if the object was to destroy the warship and enough bombers were on hand to keep up the offensive, then heavy armor piercing bombs were satisfactory to complete the task.

The inaccuracy of bombs from high altitude aircraft was shown in its relationship to Scharnhorst as map III-1 which has been reproduced on the next page shows. This map shows the Focke-Wulf factory at Bremen which was attacked 12 March, 1941. The impact of bombs which fell within at least 1,250 yards of the factory are shown by the dots with an outline of Scharnhorst superimposed in the center of the factory.

Map III-1[1] The Focke-Wulf factory at Bremen attacked 12 March 1941, with the impact of bomb hits and Scharnhorst superimposed.

The attack on German held ports by bomber aircraft was a great deal more effective in terms of warships sunk than the earlier attacks on British ports by German aircraft. The table below shows the number of each class sunk or damaged beyond repair by raids on ports and the percentages of the German ships in that class destroyed by air attacks on ports.[2]

Type of Ship	Number Lost	Percentage Lost
Battleships	1	50%
Battle-cruisers	1	50%
Pocket-battleships	2	67%
Old Battleships	1	50%
Heavy Cruisers	1	33%
Light Cruisers	2	40%
Destroyers	0	0%
Torpedo Boats	21	38%
Armed Merchant Cruisers	0	0%
Minelayers	7	30%
Submarines	65	8%

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[1]Webster and Frankland, Strategic Air Offensive Against Germany, Vol. II, p. 97.

[2]See Roskill, War at Sea, Appendix XX, German Warship Losses, 1939-1945, Vol. III, pt. 2, p. 457-461 for the losses of German surface vessels. The losses of German submarines came from Admiralty German, Italian, and Japanese U-Boat Casualties During the War.

The figures for the heavier ships, i.e. battleships through light cruisers, were so small no accurate conclusion can be drawn from these losses. For torpedo-boats and submarines the size of the force and the numbers destroyed allow some speculation on the relative effectiveness of air attacks on ports. When looking at the losses because of raids the most noticeable figures were with the exception of one submarine all the U-boat losses came after the first of 1944. Of the sixty-five submarines lost due to air raids forty-nine or seventy-five percent were lost after October, 1944, or after the French submarine bases had fallen to the advancing Allied armies. This seems to indicate that the massive concrete sub pens were an effective method of protecting the U-boats from air attack. Webster and Frankland noted that it seemed that the attacks on the submarine pens at St. Nazaire and Lorient destroyed everything but the pens.[1] This should not be construed to mean that the air attacks were ineffective in hampering submarine operations because they caused logistical difficulties. This was the case but the submarines themselves were not destroyed and a great deal of damage was done to the surrounding area.

The difficulties of sinking heavy warships by aerial bombs perhaps can best be illustrated by the attacks on the battleship Tirpitz. This ship, the sister of Bismark, was, during the period from January, 1942, until she was sunk in November, 1944, attacked by 96 Halifaxes, 7 Stirlings, 12 Albacores, 121 Lancasters, 201 Barracudas, 132 Corsairs, 20 Hellcats, 44 Wildcats, 23 Seafires, and 51 Fireflies for a total of 698 aircraft. Thirty-three aircraft were lost in attacks on Tirpitz.[2] The effect of these raids, until a special bomb was developed, was

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[1]Webster and Frankland, Strategic Air Offensive Against Germany, Vol. II, p. 97.

[2]Derived from Roskill, War at Sea, Vol. III, pt. 2, p. 170-1.

minimal.[1] Added to these attacks was an operation using midget submarines. Tho difficulties of sinking a warship in port were shown by the troubles to which this ship put the Allies before it was sunk. In order for the bomb to achieve enough velocity to pierce the armored decks on battleships and reach the vital parts it was necessary for it to be dropped from a great height. But because of inaccuracios in bombing from high altitudes the ship would more than likely be missed completely. Dive bombing against heavily defended ports and well gunned ships was to say the least a hazardous operation. The hits on Tirpitz during the raid on 3 April, 1944, wero shown by map III-2 reproduced on tho next page. During this attack six aircraft carriers, Victorious, Searcher, Pursuer, Furious, Emperor, and Fencer took part in the operation launching forty Barracudas, twenty-one Corsairs, twenty Hellcats, and forty Wildcats. All this activity which caused fourteen hits on the Tirpitz put her out of action only three months.[2] Further evidonce of the futility of attacking ships in harbor without launching massive raids was shown by tho raids on naval targets during August, September, and October, 1940. Over a thousand sorties were flown in which 683 tons of bombs were dropped on naval targets at Wilhemshavon, (Tirpitz in construction and Scheer), Kiel (Scharnhorst, Gneisenau, Lutzow, and Prinz Eugen), and Hamburg (Bismark in construction). Tho effect was some minor damage to the construction facilities but no important damage to the ships themselves.[3] Further when Hipper returned to Brest in December 1940, a hundred and seventy-five sorties and eighty-five tons of bombs were launched at her without effect.[4] The list of failures of bombers

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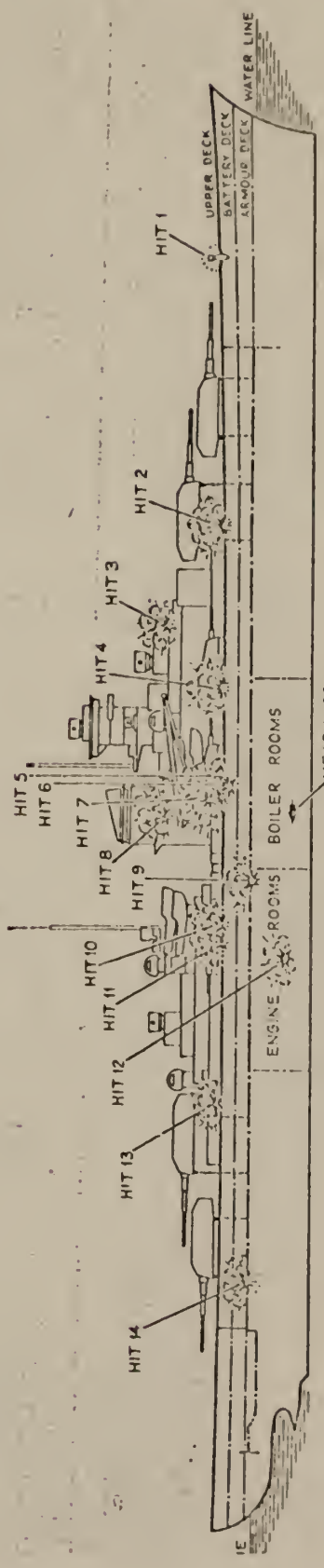
[1]For the development of the special bombs see Paul Brinkhill, The Dam Busters, (New York: Ballantine Books, 1941).

[2]Roskill, War at Sea, Vol. III, pt. 1, p. 267 and Vol. III, pt. 2, p. 170.

[3]Ibid., Vol. I, p. 261.

[4]Ibid., Vol. I, p. 292.

Map III-2 Hits obtained on Tirpitz in Attack by Fleet Air Arm Aircraft 3 April 1944.



HIT	SIZE OF BOMB (Probable)	POSITION OF HIT
1	1500 lb. A.P.	Upper deck stbd side. (Failed to detonate)
2	500 lb. M.C.	Upper deck port side.
3	500 lb. M.C.	Superstructure stbd side.
4	500 lb. S.A.P.	Upper deck port side.
5	500 lb. M.C.	Upper deck port side.
6	1600 lb. A.P.	Upper deck stbd side.
7	500 lb. S.A.P.	Upper deck stbd side.
8	500 lb. M.C.	Funnel
9	1600 lb. A.P.	Armour deck port side.
10	500 lb. M.C.	Upper deck stbd side
11	500 lb. S.A.P.	Superstructure & upper deck on the centre line.
12	1600 lb. A.P.	Stbd side armour plate.
13	500 lb. S.A.P.	Upper deck stbd side.
14	500 lb. S.A.P.	Armour deck stbd side.
NEAR MISS	500 lb. M.C. or S.A.P.	Close against stbd side.

A.P. - Armour Piercing S.A.P. - Semi - Armour Piercing M.C. - Medium Case

Roskill, War at Sea, Vol. III, pt. 1, p. 276-7

to contribute significantly to the destruction of warships could have been extended indefinitely. The one major exception to the list of failures of attacks on ports, Taranto, was accomplished not with either dive bombers or high level bombers but with torpedo planes. In a later section of this chapter the comparative value of torpedoes and bombs will be studied; in certain cases each had distinct advantages.

5. Direct attacks at sea.

There were few attacks on capital ships while they were at sea during the war in the Atlantic. The Bismark episode was one of the most famous actions but others took place, notably the Second Battle of Cape Matapan. This theater differed significantly from the Pacific. In the Pacific there were numerous attacks by aircraft on surface ships and in one of these battles the fleets never saw each other. The Pacific Theater would have been a better area of study to determine the effectiveness of direct attacks at sea.

The one action in the Atlantic where aircraft played a vital role was the Bismark tale. In this action torpedo planes from the Fleet Air Arm attacked Bismark numerous times. One of these torpedoes struck the steering and propulsion gear and rendered the ship unmaneuverable. While the main destruction of Bismark was accomplished by heavy units of the Royal Navy this destruction was only possible because of attacks by aircraft. Other than this action aerial attacks at sea in the Atlantic were limited mostly to scouting roles and attempts to harass the heavy units of the fleet.

A few general observations seemed worthwhile about direct attacks at sea by aircraft in the Atlantic. For the most part the failure of this type of attack was caused by a lack of study during the period between the wars. The actions in the Atlantic were divided by both time and country employing this method

of aerial attack. During the earlier period of the war Germany attacked numerous ocean going ships in the waters surrounding the British Isles. Large numbers of ships were damaged but few were sunk by this attack. The ships that were attacked were generally larger than the Axis ones attacked later in the war. The British attacks were against the smaller coastal vessels which plied their trade in the shallow waters off the coast of France and the Low Countries. These attacks late in the war were more successful than earlier ones because of increased effort and study in the best tactical method of attacking merchant ships at sea.

The use of aerial attacks at sea in the Mediterranean was about equally employed by both sides. A number of highly successful attacks were made on British merchant and warships in the Mediterranean during the period up to the middle of 1942. These attacks centered around two definite areas. One of the areas was the attacks around Crete. During the German invasion of Crete the British learned that surface warships could not operate far from their bases with no air cover. A large number of British warships were sunk because of the virtually absolute German aerial superiority.[1] The second area of attack was convoys proceeding to Malta. Several times the Allied convoys were forced to turn back by the combined threat of heavy Italian units and German aircraft. The invasion of Russia in 1941 drew off the crack German attack units and relieved the pressure on convoys to Malta. Still serious losses were suffered because of aerial attack on Allied convoys proceeding to Malta.

The Allies had their revenge late in the war. After the summer of 1942 Allied air superiority gained virtually complete control of the air. During this period the land campaign in North Africa was vitally affected because of the destruction of numerous ships attempting to supply the German and Italian armies fighting in the desert.

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[1]See page 72.

6. Torpedoes vs. Bombs.

Before the Second World War the Admiralty placed its faith in torpedoes as the major weapons for aircraft to use against ships at sea. According to Lt. Cmdr. P. K. Kamp the Admiralty accepted this weapon because during the First World War the torpedo had sunk more tonnage than all other means of attack combined.[1] While the leaders of the naval staff recognized the power of the torpedo as a ship-killing weapon, they did noting to develop an efficient delivery system or attack tactics.[2] This failure of sufficient study may have been involved in the lack of control which the Admiralty exerted over the air force for a long period during the time between wars.

During the war the advocates and supporters of bombers learned that they suffered numerous handicaps. As already pointed out high-level bombers were not accurate enough to hit warships in harbors, much less moving targets at sea. Dive-bombers suffered a high rate of casualties in low-level attacks. The danger of using medium bombers was shown in the Mediterranean in attacks on convoys. Because of the inaccuracies of attacks from great altitudes British Blenheims came in low over the waters and dropped their bombs so that they struck the ship nearly horizontally. These practically suicidal tactics were caused by the lack of effective dive-bombers and torpedo planes.[3] Donald Macintyre in his book on the history of battleships noted limitations of bombers and felt that high-level attacks were less effective than dive bombing attacks.[4]

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[1]Lt. Cmdr. P. K. Kemp, Fleet Air Arm, (London: Herbert Jenkins, 1954), p. 99.

[2]Robin Higham, Armed Forces in Peacetime, (Hamden, Connecticut: Archon Books, 1962), p. 228-9.

[3]Macintyre, Battle for the Mediterranean, p. 90.

[4]Donald Macintyre, The Thunder of Guns: A Century of Battleships, (New York: W. W. Norton and Company, Inc., 1959), p. 275.

The torpedo might have been the most lethal form of air attack. Admiral Raeder thought that torpedo planes could have vitally affected the course of the war. In the same conference in which he commented on the difficulties of co-operation between the air force and the navy on torpedo planes, he expressed the belief that if the Royal Navy had been attacked by a hundred torpedo planes at the beginning of the war the chances of German success at sea would have been much greater.[1] Throughout the war the only major British warship sunk as the result of a hit by an air launched torpedo was the cruiser Trinidad (8,000 tons) which was finished off by Allied forces after sustaining damage in the Barents Sea.[2]

The Russian, Korotkin, the only one who appears to have dealt with battle damage to surface ships, summarized the affect of aerial bombs and torpedoes. He recognized that since bombs destroyed the above water parts of ships and also the underwater hull, the effects were different than torpedoes which destroyed just underwater sections. Shock, damage far from the location of the hit, was not one of the characteristics of damage on armored warships hit by armor-piercing bombs. Wartime experience showed that direct hits by armor-piercing bombs were more effective than near misses. This effect was because bombs designed to break through armor plate on warships did not carry enough explosive to cause serious complications when exploding in the water. The effect of high explosive bombs was mostly topside. The first and second deck were usually damaged as were the engines if the bombs fell in the vicinity of the machinery rooms. When high explosive bombs landed near the ship the underwater damage was similar to mines.

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[1] Fuehrer Conferences, Vol. II, 1941, Report of the Commander in Chief, Navy to the Fuehrer, 29 December, 1941, p. 95.

[2] Admiralty, Ships of the Royal Navy.

In order to destroy a large World War II vintage battleship about eight high explosive bombs of 5,000 kilograms (11,000 pounds) each were necessary. Mostly hits with some explosion near the ship were required to complete the destruction.[1]

Torpedoes exploding against the side of a ship had a greater tendency to destroy the watertight integrity of the ship. Other than allowing water to enter, the damage was characterized by the locality wherethe hit took place; i.e. in the boiler rooms it put out fires, in the after extremities it ruined the propulsion and steering, etc. The damage to the armaments was characterized by the flooding of magazines and cutting off of electrical power.[2] Korotkin devised a chart showing the number of hits necessary to destroy or seriously disable different classes of battleships.[3]

Type of Battleship	Displacement Standard Tons	Number of Torpedoes Necessary To:	
		Sink	Put Out of Action
Heavy Construction (World War II)	45,000-60,000	8-10	4-6
Light Construction (World War II)	30,000-35,000	4-6	3-4
Construction during (World War I) (Modernized)	25,000-30,000	2-3	1-2

It seemed that torpedoes were much more effective weapons to attack armored ships than were bombs. In order to deliver a 11,000 pound bomb a heavy four engined bomber would have been necessary. This plane would have had to bomb

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[1]Korotkin, Battle Damage to Surface Ships During World War II, p. 199-202.

[2]Ibid., p. 194-6.

[3]Ibid., p. 197.

from high altitude because of its vulnerability to ack-ack and size. This would have made its accuracy minimal. Torpedoes, on the other hand, caused at least as much damage as a 11,000 pound bomb and were carried by smaller planes. While the figures are not available to perform a satisfactory comparison it seems that torpedo planes may have been more accurate than high-level bombing. Also while the losses were higher for torpedo planes they were much cheaper aircraft than four-engined bombers. The torpedo plane's effectiveness was limited because of insufficient inter-war study and a lack of proper delivery systems.

7. Anti-aircraft fire and defensive measures against aircraft.

During the war the gunlayers were disappointed because of the inability of their weapon to bring aircraft down. The volume of fire needed to bring down aircraft or deter one from driving home its attack surpassed all estimates made before the war.[1] The increased need for anti-aircraft armament was shown by the increase of guns suitable for this type of work on Rodney and Nelson. These two battleships were completed in 1927 with six, 4.7 anti-aircraft guns and eight, 2 pound pom-poms. The final anti-aircraft armament on the two battleships was six, 4.7 anti-aircraft guns; sixteen, 40 millimeter guns; forty-eight, 2 pound pom-poms; and sixty-one, 20 millimeters.[2] It was found that not only was accuracy needed to bring down aircraft but great quantities of fire were also needed. Edgar March, who wrote the history of British destroyers, noted that before the war eye-sighted weapons were considered sufficient to bring down aircraft. During the war it was discovered that this was not the case.[3]

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[1]Higham, Armed Forces in Peacetime, p. 228.

[2]Parkes, British Battleships, p. 654.

[3]Edgar J. March, British Destroyers: A History of Development, 1892-1953, (London: Seeley Service and Co., Ltd., 1966), p. 402.

Admiral Pugsley, who was closely associated with destroyers both before and during the war, noted that destroyers lacked sufficient anti-aircraft armament. Destroyers at the beginning of the war were very nearly unarmed in weapons to attack airplanes. They usually included a number of 4.7 inch guns which could not elevate above 40°, and were therefore unsuitable for this employment. The only other armament was two, 0.5 inch machine guns and one, 2 pound pom-pom.[1] Pugsley implied that the Admiralty laughed at the threat from aircraft and concentrated on low angle guns.[2] If this was the case it seems to illustrate the disbelief that the airpower enthusiasts' ideas were viewed by the Admiralty. Conversely, the supporters of airpower disbelieved a warship could survive at all under the threat of air attack.

The importance of sufficient anti-aircraft fire was shown many times in the Mediterranean. This closed sea was perhaps the ideal place for aircraft to operate against ships, narrow with both sides of the shoreline occupied many times by Britain's enemys. During the operations around Crete in 1941 a task force comprising the cruisers Ajax and Orion was compelled to withdraw from a sweep along the north side of the island because of a shortage of anti-aircraft ammunition.[3] During the trials before the war the effect of anti-aircraft guns was greatly over-rated by the Admiralty and under-rated by the air force. Roskill noted that when anti-aircraft guns were used as a convoy escort, particularly on the Arctic route, they were valuable, but when they attempted to replace shore-based guns they were extremely vulnerable.[4]

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[1]Pugsley, Destroyer Man, p. 33.

[2]Ibid., p. 68.

[3]Lt. Cmdr. P. K. Kemp, Victory at Sea, (London: Frederick Muller, Ltd., 1957), p. 134-5.

[4]Roskill, War at Sea, Vol. I, p. 84.

Another means of defense of surface ships was swift evasive action or zig-zagging. When, during the test before the war, aircraft were sent out to attack the old battleship Agamemnon the effects of evasive action were not considered. In 1923 this ship was attacked by R.A.F. bombers and out of six bombs two hits were scored and four misses were close enough to have caused some damage. This caused the leaders to believe that battleships were obsolete when in range of enemy aircraft. But this test did not include evasive action, anti-aircraft fire, escorts and fighter protection.[1]

During the war new tactics were developed in attempts to diminish the effects of evasive action and of anti-aircraft fire. One of these was the flooding of the defenses with more aircraft than warships could handle. Successful attacks were made on capital ships provided that the defenses could be saturated. A successful attack tactic was developed by Pat Gillis where several Beauforts attacked from different directions to spread out the defensive fire and confuse the ships trying to evade torpedoes.[2] This was the method employed by the Japanese in December 1941, when they sank the British capital ships Prince of Wales and Repulse in the Pacific.

Bernard Brodie had little faith in evasive action as a method to protect surface ships from aircraft. He felt that it might cause the enemy to make many misses but the enemy could keep coming and one hit paid for many misses.[3] He failed to realize that every miss moved the ship closer to a safe position and caused the aircraft to make another attack so that it had more chances to be shot down.

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[1]Kemp, Fleet Air Arm, p. 110.

[2]Flight Lt. Ralph Barker, The Ship-Busters: The Story of the R.A.F. Torpedo Bombers, (London: Chatto and Windus, 1957), p. 195-6.

[3]Bernard Brodie, Sea Power in the Machine Age, (Princeton, New Jersey: Princeton University Press, 1943), p. 414.

8. The effect of aircraft during the Second World War.

Aircraft during the war in the Atlantic varied greatly. Until about the summer of 1943 aircraft were seldom employed as anti-submarine weapons. After this period they replaced destroyers as the prime antagonists of the U-boats. Their importance as weapons to destroy ships in port and logistical facilities increased after this period as did nearly every other method of using aircraft.

Since only two British battleships and one battle-cruiser were lost in the Atlantic the number fails to justify any broad generalizations. The first of the battleships lost was Royal Oak (29,150 tons) completed in May 1916. The other was Barham (31,100 tons) commissioned in 1915. Both of these ships were sunk by torpedoes but the torpedoes were not launched by aircraft. Hood (42,100 tons) was the battle-cruiser which was lost in a gunnery duel with the German battleship Bismark.

The German battleships Tirpitz and Bismark (41,674 tons each) and the battle-cruisers Scharnhorst and Gnesienau (31,857 tons each) were similarily too few in number to make any generalizations about the effectiveness of aircraft. Torpedo planes played a prominent role in the destruction of Bismark in that they destroyed the propulsion and steering gear of the ship and allowed the British pursuers to catch up. Tirpitz was sunk by a special force of high-level bombers in Norway. Scharnhorst was sunk by destroyers and the British battleship Duke of York. Gneisenau was scuttled after suffering a bomb hit while undergoing repairs after striking a mine.

The following table shows the percentages of ships belonging to the Royal Navy that were lost due to air attack in the Atlantic out of the total number lost because of enemy action.[1]

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[1]Admiralty, Ships of the Royal Navy.

Type of Ship	Number Lost	Percentage
Battleships	0	0%
Aircraft Carriers	0	0%
Cruisers	8	35%
Destroyers	48	36%
Submarines	4	5%
Armed Merchant Cruisers	0	0%
Monitors	1	100%
Anti-aircraft ships	7	64%
Mine vessels[1]	18	27%
Corvettes, Sloops, Cutters, Frigates	9	18%
Trawlers	72	29%
MTB-MGB-Launches	27	12%
Other[2]	60	13%

The one type of ship whose primary duty was to protect other vessels from aircraft, the anti-aircraft ship, was in a percentage sense, the most vulnerable of all the ships that had any percentage figures except monitors. An author in an argument for the retention of anti-aircraft cruisers noted that no British capital ship was lost because of either Italian or German air attack when accompanied by anti-aircraft cruisers.[3] While admittedly some of the anti-aircraft ships were quite small and old, others were new and large. The anti-aircraft ship Pozarica displaced 4,540 tons and was commissioned in 1941. This loss of AA ships seemed to mean that they could protect others from air attack but were themselves vulnerable. While no proof has been found it was almost certain that the German and Italian pilots picked out anti-aircraft ships in order to make their later attacks on other vessels easier.

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[1]Mine vessels include layers, sweepers, detonation and other vessels which dealt with mines more or less exclusively.

[2]The "other" term is a catch-all phrase for everything from whalers to barges.

[3]Norman Friedman, "Anti-aircraft Cruisers," USNIP, Vol. 91, no. 1, January, 1965, p. 91-2.

Destroyers and cruisers suffered the next highest rate of losses. This fact might be explained by their being high priority targets not possessing the heavy armor plate of battleships. Other vessels were sunk in varying proportions by aircraft. The British lost remarkably few submarines because of Axis air attacks. This phenomenon was explained because aircraft as anti-submarine weapons did not achieve full potential until the Axis air forces had been defeated.

The proof of the impossibility of surface craft to operate without air protection in waters controlled by enemy aircraft was found in the operations off Crete during 1941. In May of that year the cruisers Fiji, Gloucester, York, and Calcutta and the destroyers Juno, Greyhound, Kashimir, Kelly, Hereward, and Imperial were lost because of air attacks in the eastern Mediterranean.[1] In a period of a little more than a week over 36,000 tons of British warships were lost during the evacuation of Crete. If the same rate of loss had occurred throughout the war, over ten million tons of British cruisers and destroyers alone would have been lost to air attacks; these losses would have eliminated the Royal Navy several times over. Admittedly the figures for this one period were artificially high because of the necessity of evacuating troops from Crete no matter what the losses. Naval leaders got the point that it was certainly dangerous to operate surface vessels far from air cover.

The comparative effectiveness of direct attacks and mine attacks on merchant shipping were such that except for the very short period at the start of the war when German shipping was being rounded up by surface units of the British Navy, air attacks were second only to mining operations in the total tonnage lost to the Axis Powers.

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[1]Admiralty, Ships of the Royal Navy.

An interesting correlation was found by comparing the two tables (III-3 and III-4) on the following page. Generally, the earlier parts of the year were the most favorable for direct attacks at sea by R.A.F. aircraft during the war. It was noticable that when more sorties were undertaken during this time of year more vessels were sunk or damaged. The number of aircraft was not in direct relation to the number of sorties. Sometimes a great many aircraft were lost while participating in operations against enemy ships per sortie. During other periods, such as the high period during the war; the first quarter of 1944, when 5,382 sorties were flown only 44 aircraft were lost, the number of aircraft lost were small compared to the number of sorties.

The same figures which were performed in the analysis of mines in chapter two led to the following figures.

Average tonnage of each ship lost----------1,107.0000
Average tonnage of each ship damaged---------3,410.0000

Average tonnage sunk per sortie----------7.7836
Average tonnage damaged per sortie----------7.7390

Average tonnage sunk per attack[1]----------44.2740
Average tonnage damaged per attack----------37.6950

Average tonnage sunk per plane lost----------418.5000
Average tonnage damaged per plane lost---------416.0000

It was readily noticeable by comparing the two tables that the tonnage of the average ship lost to aircraft was considerably greater than those sunk by mines. At the same time the attacks for mines had a greater tonnage sunk per sortie than direct attacks at sea. When an airplane did attack ships the tonnage lost was greater than when an airplane planted a mine. It was evident that the

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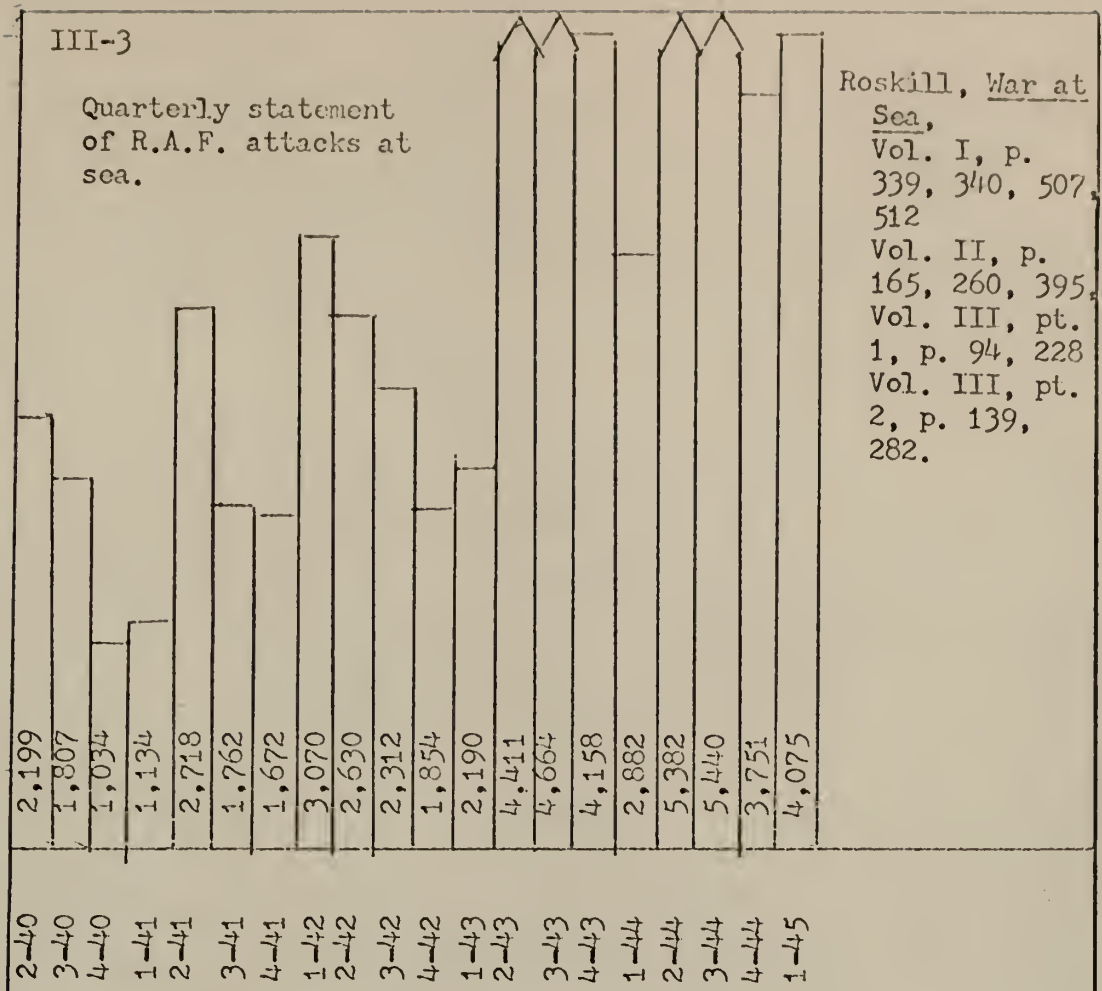
[1]This information for the attacks made was only available for the period from January 1942 to March 1945. All other figures such as tonnage lost or damaged have been reduced for this one figure to cover only this period. It is quite possible that a change might be evident if the information were available for attacks made during the period from April 1940 to December 1941.

III-3

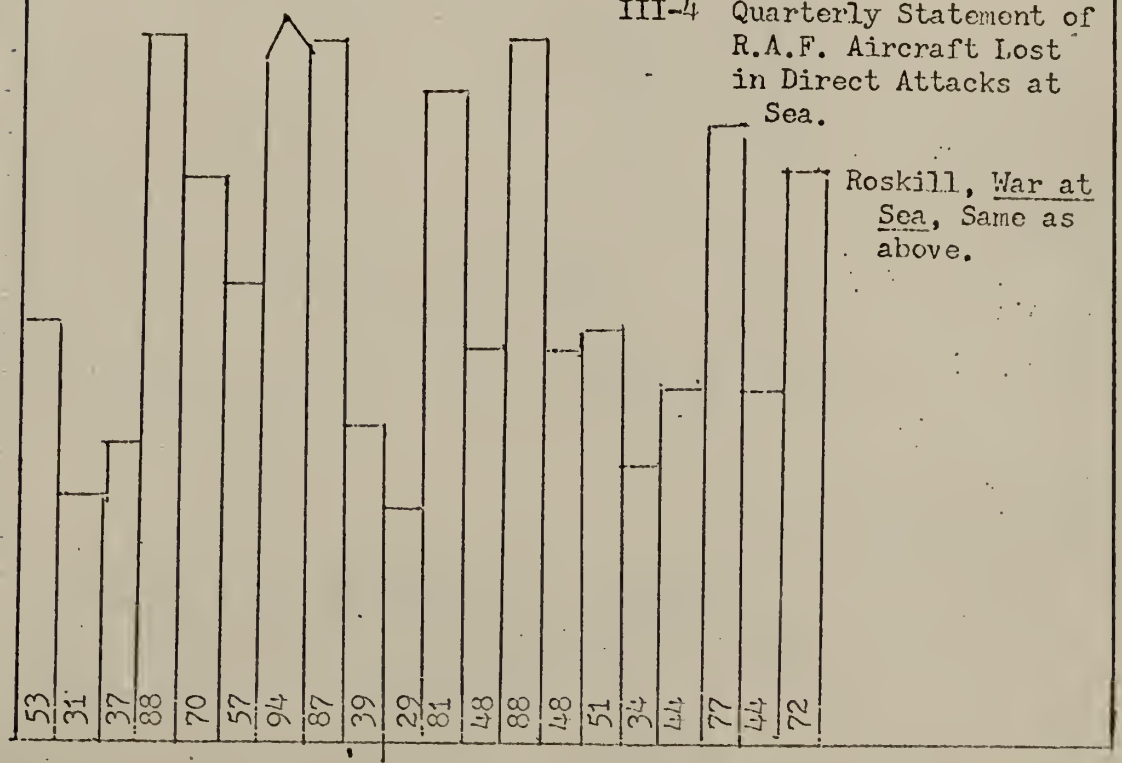
Quarterly statement of R.A.F. attacks at sea.

Roskill, War at Sea, Vol. I, p. 339, 340, 507, 512
Vol. II, p. 165, 260, 395,
Vol. III, pt. 1, p. 94, 228
Vol. III, pt. 2, p. 139, 282.



III-4 Quarterly Statement of R.A.F. Aircraft Lost in Direct Attacks at Sea.

Roskill, War at Sea, Same as above.



figures for the tonnage damaged per attack differed significantly from the tonnages lost and damaged per plane lost or per sortie. This was in large part due to the fact that the average tonnage per ship lost during the latter part of the war was significantly lower than at the first of the war. During 1944 and the first quarter of 1945 the average tonnage per ship lost by direct attacks in the Atlantic was 866.66. This was significantly lower than the 1,107.0 average for the entire war. The figures for the average ship damaged were lower for the last two years of the war; they were 3,072.53 as compared with 3,410.0 for the entire war. This leads to the conclusion that while attacks and sorties remained relatively steady during this period the targets were becoming smaller. Mines laid by aircraft sank and damaged more tonnage than did aircraft. Direct attacks at sea sank 452,815 tons and damaged a further 450,125 tons of Axis shipping. Mines sank 704,711 tons and damaged 476,676 tons. Compared to aircraft lost per ton sunk, minelaying aircraft were more effective than were attack planes. For each plane lost during air attacks 418.50 tons were sunk, and for each plane lost during minelaying operations over 1,300 tons were sunk.

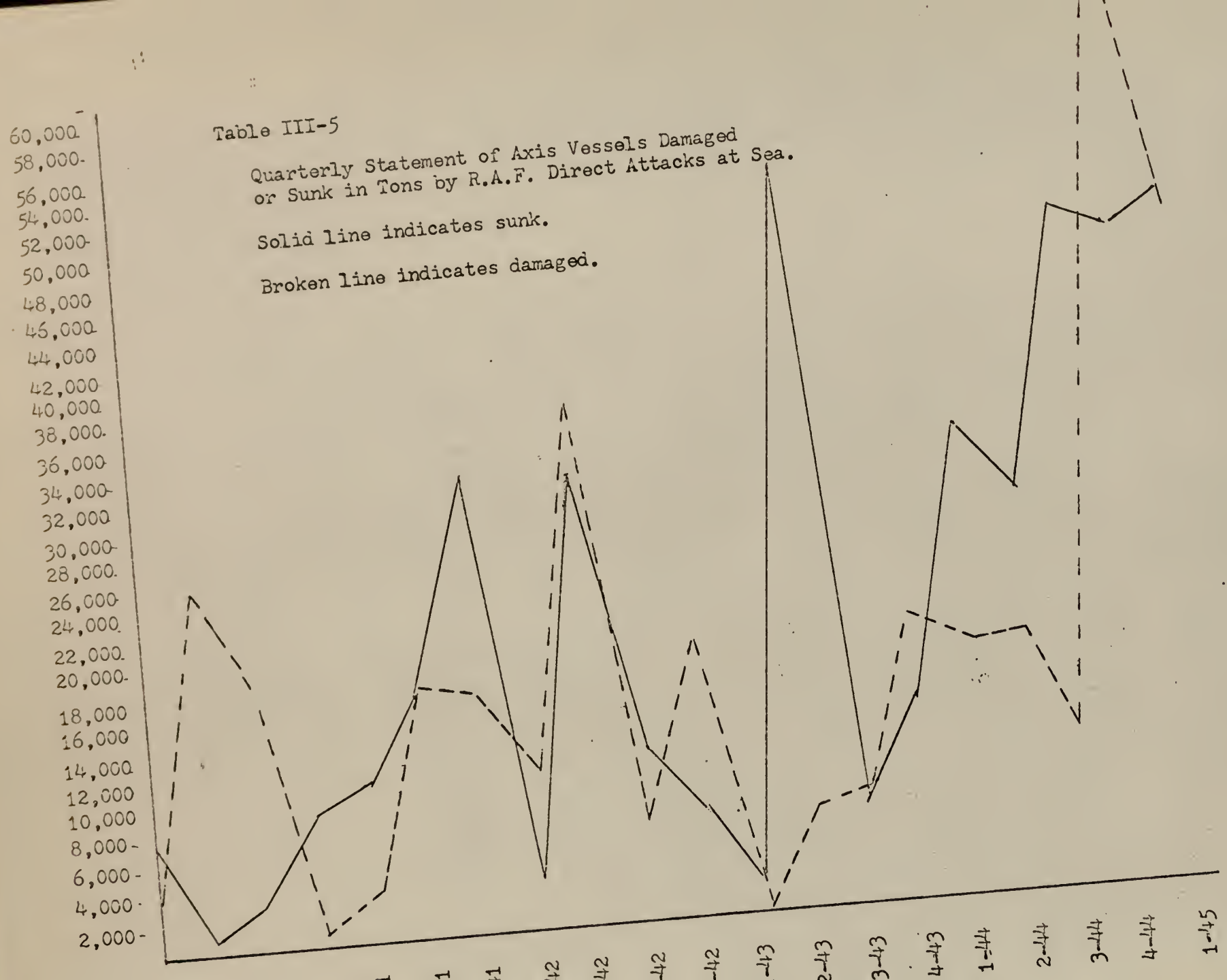
Mines were more effective than direct attacks at sea by aircraft, but this did not exclude the air attacks as an effective method. On many occasions aircraft while attacking at sea could accomplish tasks which mines could not. Perhaps the most obvious of these were attacks on ships which were sailing in waters too deep to be mined. Also, given proper identification, which was a problem, aircraft were selective in their targets; being able to distinguish friend from foe and detect the most worthwhile of several targets. The most blatant ability of aircraft was its ability to reconnoiter and find targets. An airplane performing direct attacks at sea could spot enemy movements or even shift its position until it found better hunting; the mine remained stationary or drifted aimlessly.

Table III-5

Quarterly Statement of Axis Vessels Damaged or Sunk in Tons by R.A.F. Direct Attacks at Sea.

Solid line indicates sunk.

Broken line indicates damaged.



Perhaps one of the best examplos of the aircraft's unusual ability in attacks at sea was seen in the attacks upon U-boats in the Atlantic. In this campaign the aircraft started meagerly and finished as the nemesis of the German submarines. Table III-6 shows the losses of German U-boats because of aerial attack by quarters and clearly illustrates the rising losses. During the latter parts of the war, particularly during 1944 and early 1945, the losses of submarines declined. This was due, in large part, to declining tactical losses while strategic losses, which are not especially delineated, increased. During the entire war 218 German submarines were lost because of air attack alone and airplanes assisted surface vessels in a further 43 kills. Aircraft by themselves sank 27.9% of German U-boats and these losses added to the assists made aircraft the greatest killer of submarines. But as was noted in Table III-6 there were no kills in 1939 and only four assists in 1940; aircraft took some time to come into its rightful place as a U-boat killer.[1]

Grand Admiral Doenitz throughout the Fuehrer Conferences complained that aircraft were the greatest threat to his submarines.[2] The use of aircraft was a double edged sword for the Germans. They not only used aircraft for attacks on ships but they assisted the submarines in finding and shadowing convoys so the U-boats could concentrate against them. The most commonly used aircraft for these operations was the Focke-Wulf 200, more commonly known as the "Condor." This aircraft had little to recommend it except its long endurance. It took off from bases in France and flew around the British Isles and often returned to

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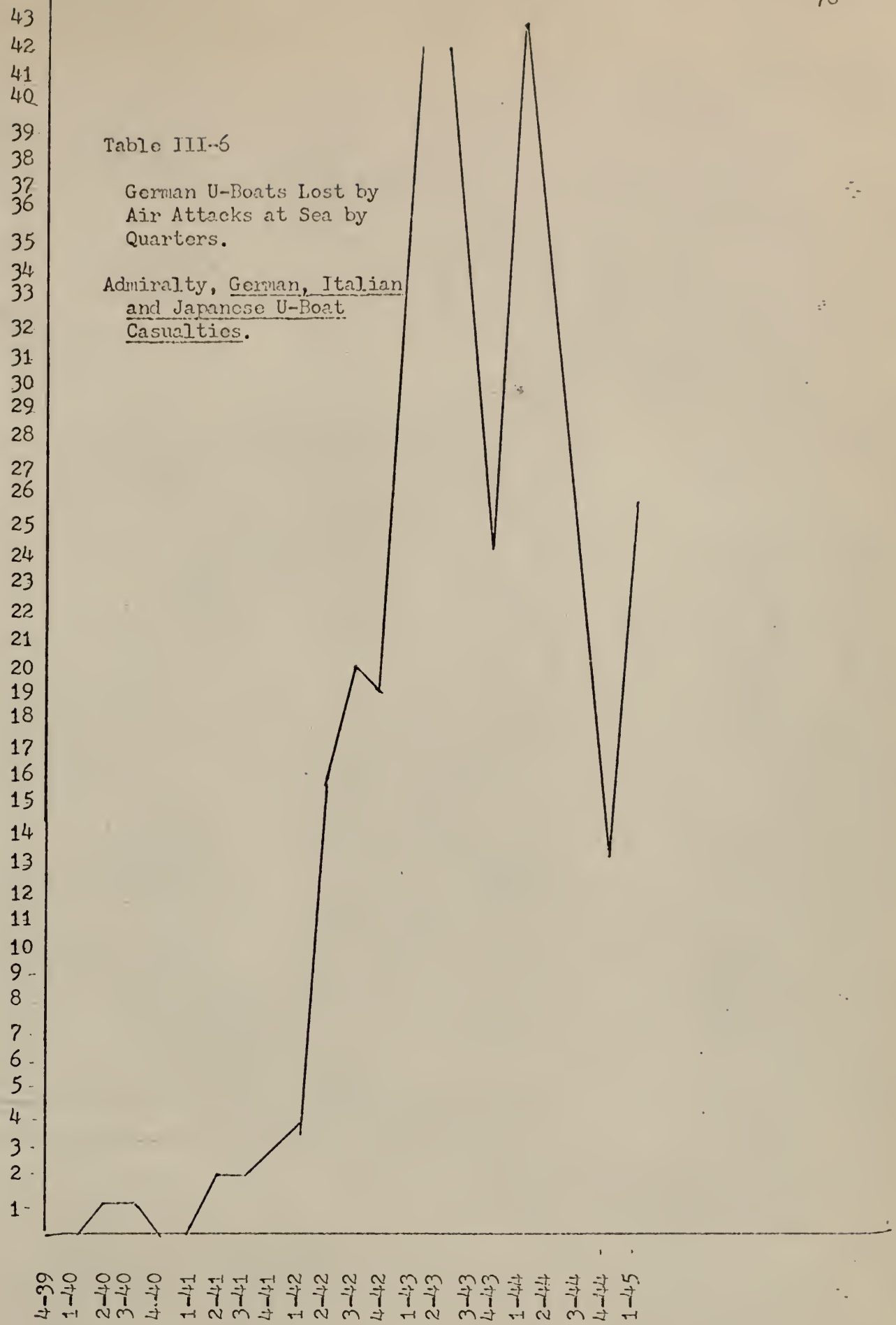
[1]Admiralty, German, Italian and Japanese U-Boat Casualties.

[2]Fuehrer Conferences, 1942, Report of the Conference with the Furhrer, 28 September 1942, p. 119. This particular conference has been chosen for the footnote because it showed that the German leadership recognized the threat to their submarine forces from air attacks at sea before these attacks really reached their peak.

Table III-6

German U-Boats Lost by Air Attacks at Sea by Quarters.

Admiralty, German, Italian and Japanese U-Boat Casualties.



Norway.[1] Green noted that it sank hundreds of thousands of tons of Allied shipping and gave the Atlantic convoys a real battering.[2] This was not exactly true in the sense that the aircraft did it themselves, but that the submarines which they called to attack convoys did sink hundreds of thousands of tons of Allied shipping. In an indirect sense the "Condors" were responsible for many of the Allied ships which were sunk by Axis submarines because had they not spotted the convoy and reported its position the submarines would not have been able to attack the ships.

Part of the problems of attacks by submarines, and shadowing "Condors," were alleviated by increasingly long-range aircraft and escort carriers for the merchantmen. Even if aircraft, either shore based or carrier-borne, did not sink the submarine, they often forced it to submerge and once a submarine had submerged it could no longer move to an attack position or follow the convoys while reporting its movements. The figures on how many Allied ships were saved because submarines were forced to operate defensively do not exist but there was little question that a substantial portion of the Allied ships crossing the Atlantic were saved by this tactic. Figures which were presented on page 68 listed air attacks launched from carriers as attacks solely as air attacks and not as assists. Of the U-boats sunk solely by aircraft during the war 18.3% of these attacks originated on a carrier and of the submarines sunk by both aircraft and surface vessels 27.9% of the aircraft participating came from carriers.[3]

A study of the British merchant vessels revealed some interesting aspects of air attacks on shipping. From the four tables (III-7, III-8, III-9, III-10)

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[1]William Green, Famous Bombers of the Second World War, (Garden City, New York: Doubleday and Company, Inc., 1960), Vol. II, p. 72.

[2]Ibid., p. 72.

[3]Admiralty, German, Italian and Japanese U-Boat Casualties.

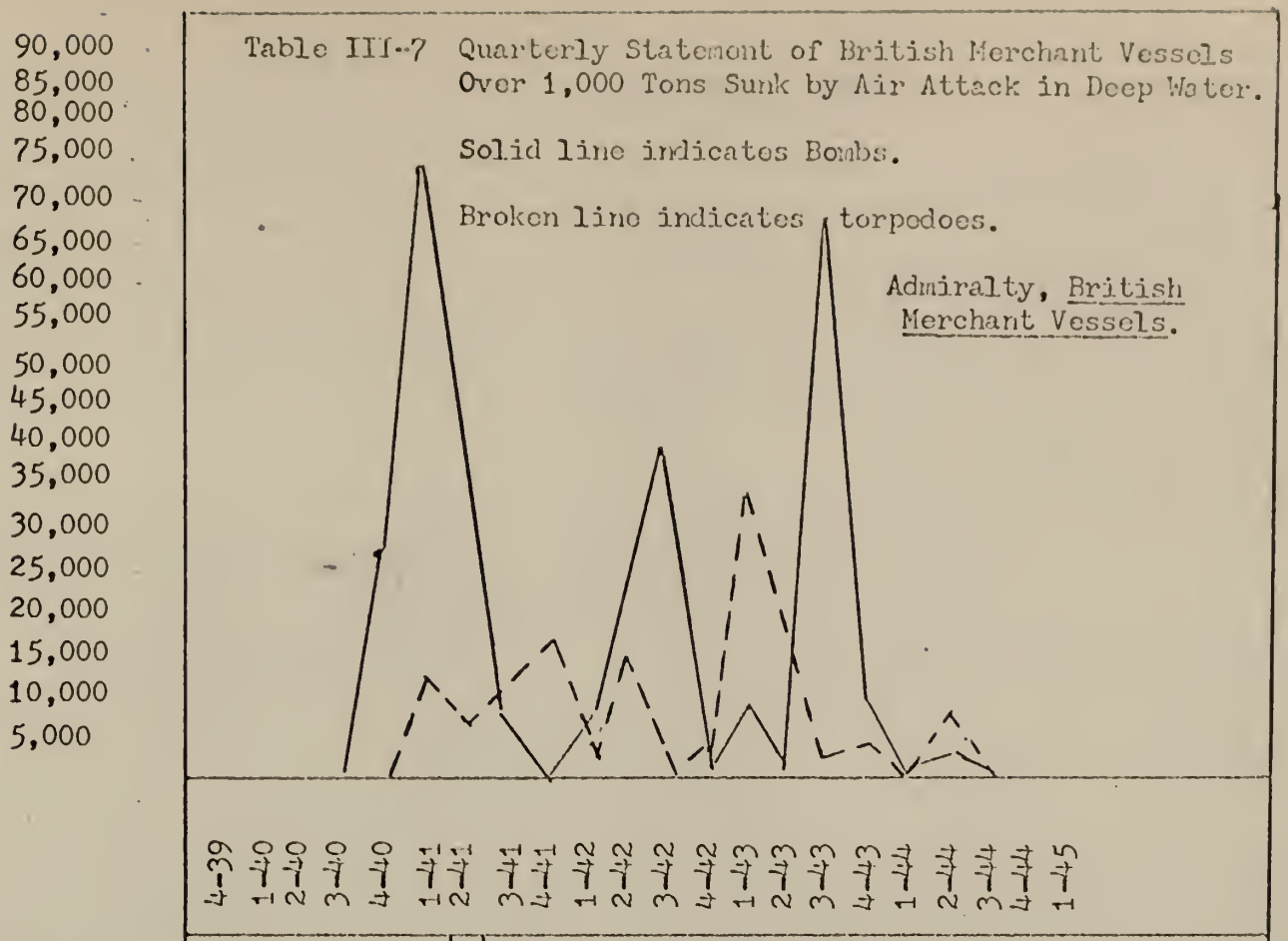


Table III-7 Quarterly Statement of British Merchant Vessels Over 1,000 Tons Sunk by Air Attack in Deep Water.

Solid line indicates Bombs.

Broken line indicates torpedoes.

Admiralty, British Merchant Vessels.

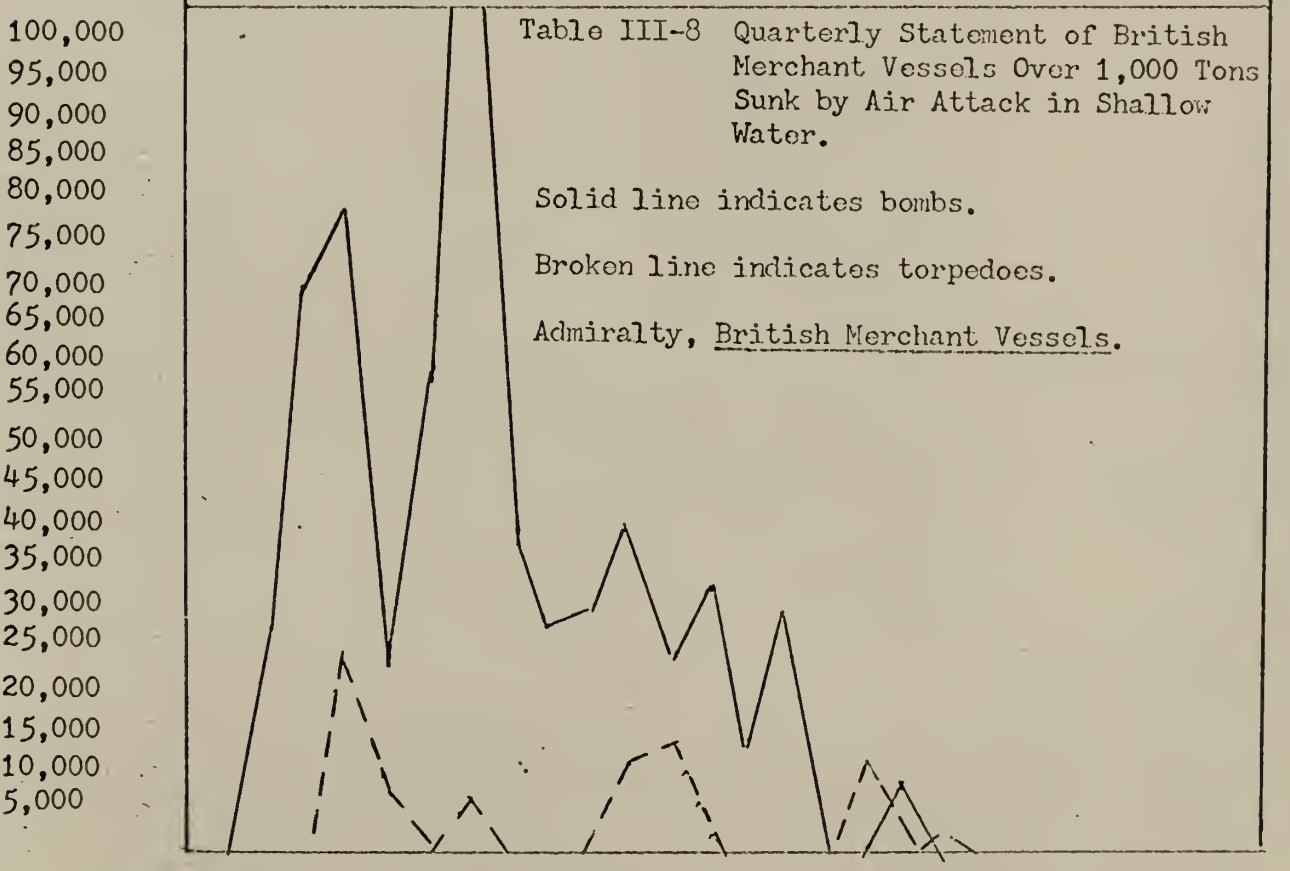


Table III-8 Quarterly Statement of British Merchant Vessels Over 1,000 Tons Sunk by Air Attack in Shallow Water.

Solid line indicates bombs.

Broken line indicates torpedoes.

Admiralty, British Merchant Vessels.

Table III-9 Quarterly Statement of British Merchant Vessels Over 1,000 Tons Damaged by Air Attack in Deep Water.

Solid line indicates guns and bombs.

Broken line indicates bombs.

Dotted line indicates torpedoes.

Admiralty, British Merchant Vessels.

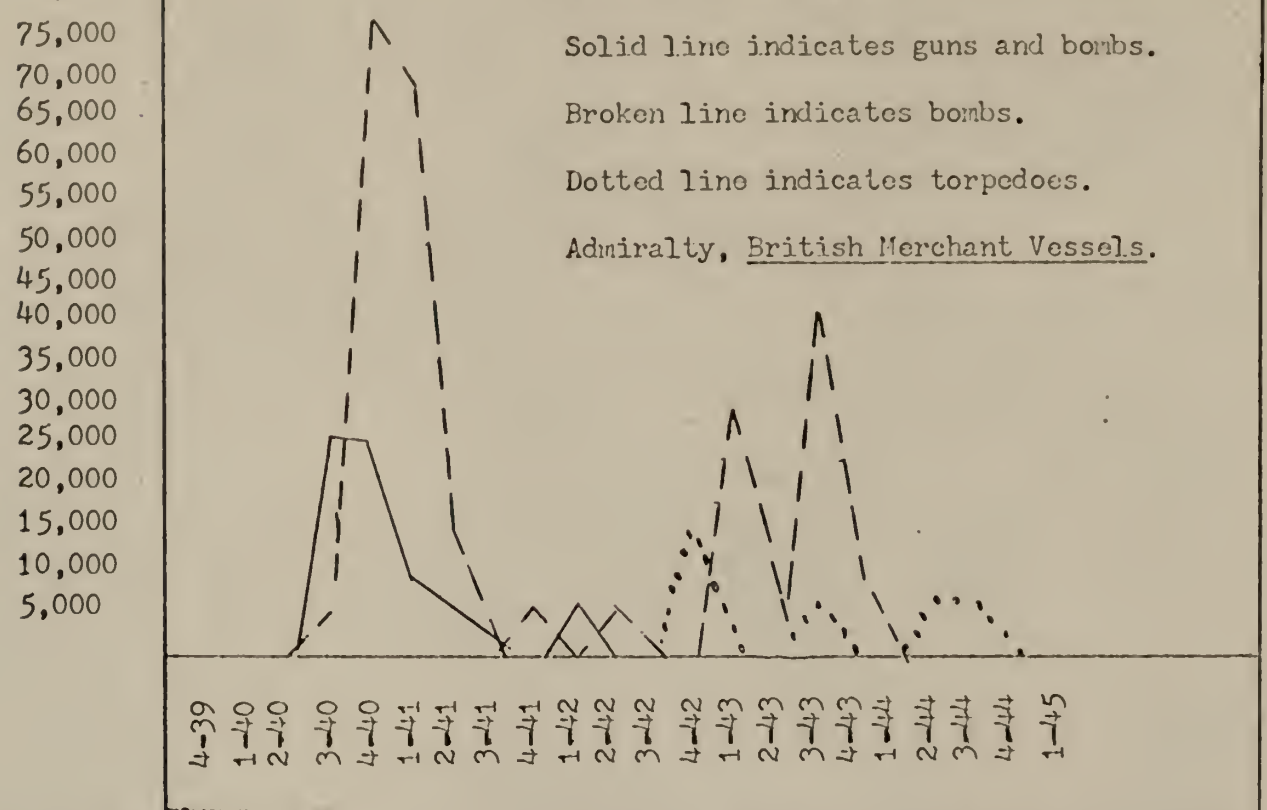
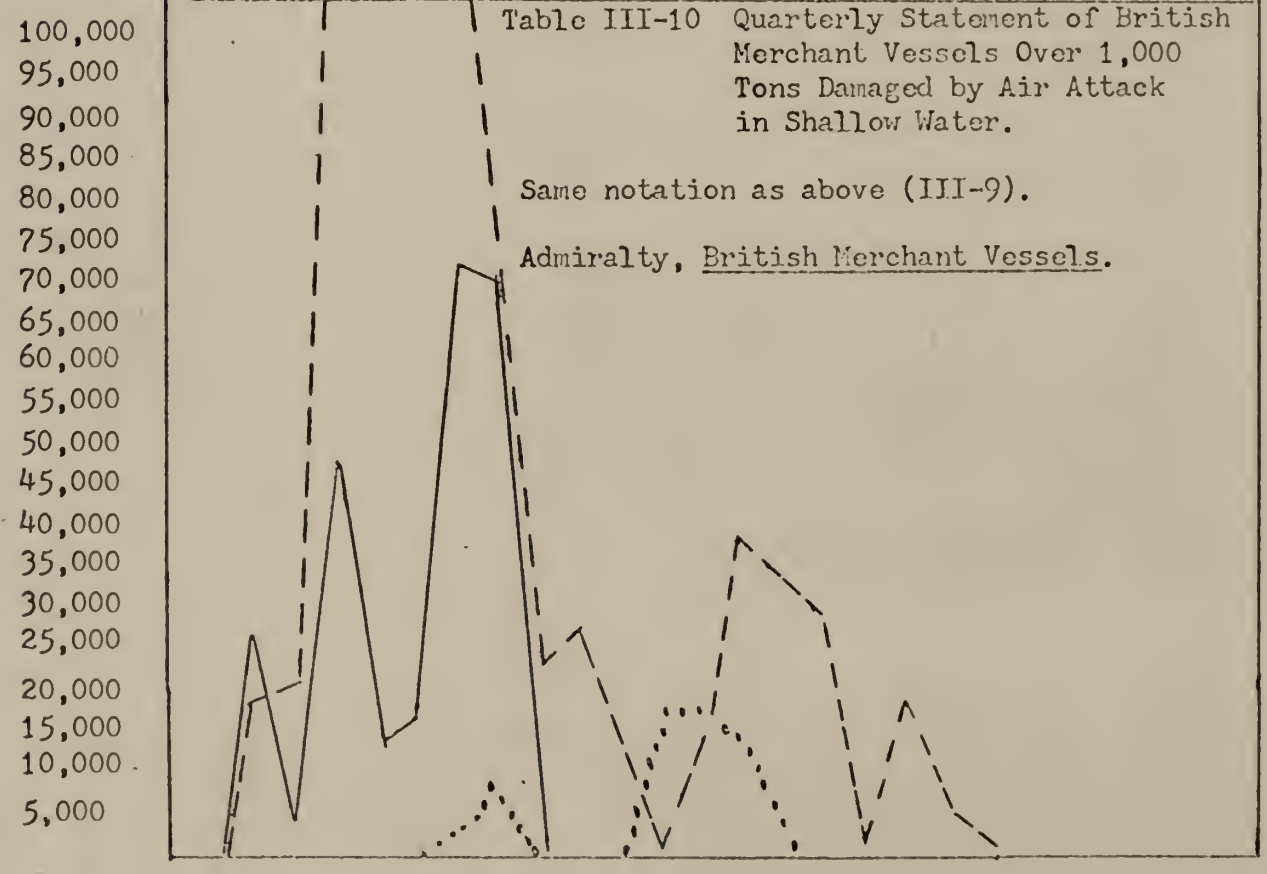


Table III-10 Quarterly Statement of British Merchant Vessels Over 1,000 Tons Damaged by Air Attack in Shallow Water.

Same notation as above (III-9).

Admiralty, British Merchant Vessels.



On the foregoing pages it was evident that the torpedo as a weapon for airplanes on merchant ships came late in the war. These figures for losses from torpedo attacks ran consistently lower than figures for attacks with bombers. In nearly every case the figures for torpedo losses started after those for bombers and faded out sooner. How much the lack of training and tactics for torpedo-bombers contributed to its virtual impotence is questionable but supposing training had been present at the first of the war, the German air forces would have been able to make better use of this weapon. As it was, the victory in the air was virtually won before the torpedoes as weapons to attack ships appeared.

After looking and comparing the table for air attacks in shallow water and deep water the bomb and torpedo, when used with aircraft, were basically shallow water weapons. This was due in large part to the fact that the British Isles, where the heaviest concentrations of shipping met, were surrounded by shallow water. It was also interesting to note that the losses suffered were highest during the attacks on Britain. Particularly interesting, was that the German attacks on shipping in shallow water damaged several times more ships than they actually sank. The high points for damaging ships occurred during the period from the second quarter of 1940 to the second quarter of 1941. It was much better to sink a ship than damage one; it took the British repair yards an average of 190 days to repair a ship that was damaged by enemy action. The Admiralty figured after the war that 142,500 ship days were lost to British shipping which was equal to 65 ships or 340,000 tons lost for the entire war.[1]

9. Aircraft Carriers.

While carriers should be included in the next chapter on capital ships it seemed that because of their close connection with aircraft they should

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[1]Admiralty, British and Foreign Merchant Vessels, p. 12.

be included in this section. The aircraft carrier's main advantage was that its striking range was much greater than the most powerful gun on a battleship. The most powerful of battleships could not strike an effective blow much over 25,000 yards. The aircraft carrier on the other hand could launch its aircraft and strike at ranges of perhaps 200 miles. The difficulty with aircraft carriers was that they had no inherent striking power of their own.[1] The one time a capital ship approached within gunnery range of a carrier the flattop was easily destroyed. The British carrier Glorius returning from Norway with a load of planes was discovered by the German battle-cruisers Scharnhorst and Gneisenau in the spring of 1940. They approached within gunnery range before the Glorius launched its planes and opened fire at 27,000 yards. Glorius was quickly destroyed.[2]

While the aircraft carrier played notable roles in the Atlantic their usefulness in fleet actions was not equal to the campaigns in the Pacific. Aircraft carriers played prominent roles in the destruction of Bismark and a number of the "convoy" battles in the Mediterranean, but never in the Atlantic were they responsible for the destruction of an opposing fleet.

The aircraft carrier achieved great successes in the anti-submarine war. It was traditionally used by the American forces as the center of the hunter-killer groups. The British used them more often to escort convoys. Terence Robertson, who wrote the biography of Capt. Walker, felt that using carriers as close escort for convoys was dangerous and had little value. He felt this way because most submarine attacks came at night when air spotting was ineffective.[3] The first kill by an aircraft launched from an American escort carrier

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[1]Brodie, Sea Power in the Machine Age, p. 428.

[2]March, British Destroyers, p. 257.

[3]Robertson, Walker, R. N., p. 158.

was the U-569. The plane was launcehd from USS Bogue May 22, 1943.[1] After this first sinking there were increased numbers of U-boats which were sunk by aircraft from carriers. Not only did the escort carriers cause a large number of sinkings but they kept the pressure on the German submarine crews and allowed them no safe area to rest and recuperate until the next attack. More will be said about hunter-killer groups in a later section but in the American use of this tactic the carrier was a very central piece.

Carriers had two advantages. Land based planes had to return to their bases on shore which often left the fleet without aircover for long periods of time.[2] The land based planes had to stay over the fleet constantly and use up fuel before an attack by an opposing air force of the land based planes arrived. The second ability was explicitly stated by the German Admiral commanding the German naval forces in the Mediterranean. In Adm. Weichold's essey which he wrote after his capture, he noted that the British aircraft carriers in the Mediterranean gave them the ability to rapidally exploit any naval situation.[3] The aircraft's main feature was versitility and the carrier added to this by taking the planes with the fleet.

The aircraft carrier may have become the new "queen of the seas" during the Second World War but this was not due to its inherent destructive ability but because of the planes which it carried.

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[1]Naval History Division, Office of the Chief of Naval Operations, United States Submarine Losses, World War II, (Washington, D. C.: U. S. Government Printing Office, 1963), p. 163.

[2]Macintyre, Battle for the Mediterranean, p. 154.

[3]Adm. Eberhard Weichold, The War at Sea in the Mediterranean, (Washington, D. C.: Office of Naval Intelligence, 1947), p. 23.

10. Conclusion about aircraft in the Atlantic naval war.

The one facit which seems safe to say about the air war in the Atlantic was that none of the predictions about air power before the war were correct. The air power enthusiasts were wrong on two counts: their weapons could not force a country into submission solely through the efforts of strategic attacks nor were capital ships seriously threatened when at sea. The naval leaders erred because they failed to recognize the extreme potency of this new weapon. Whether or not it was possible to destroy a fleet solely with air power made no difference, air power became an additional factor which had to be considered in tactical and strategical dispositions. The airplane during the Second World War in the Atlantic became the primary but not the only weapon of naval warfare.

The question on the value of strategic air attacks is still open to a number of different interpretations but it seems that perhaps a number of mistakes were made. The most important question which needs to be answered was whether the emphasis on strategic raids was important enough to shortchange the needs of the service actually combating ships at sea. Since the bombing offensive failed to produce expected results and in fact the results did not start until late in 1944 it was not worthwhile. Because of this Roskill in his Lees-Knowles lectures felt that the Bomber Command's priorities were wrong.[1]

The airplane achieved its greatest success against the heavy units, not at sea as they did in the Pacific, but while the heavy ships were in port. The one ship that was sunk in part because of aircraft at sea was done so by torpedoes, not bombs. In order for bombing attacks to be successful it was necessary for heavy bombers to be used so that heavy bombs could be dropped from high altitudes

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[1]S. W. Roskill, The Strategy of Sea Power: Its Development and Application, (London: Collins, 1962), p. 180.

where they achieved enough velocity to penetrate the armor deck. After the German submarines were forced out of their reinforced pens they too became vulnerable to aerial attacks on ports.

In attacks at sea the lighter ships were vulnerable to aerial attack. This was due to a lack of armor protection and sufficient gunfire to drive off aircraft. The losses of merchant ships were mostly in shallow waters, but aircraft were much better weapons to damage ships than to sink them. In one field airplanes as weapons of naval warfare became dominate. Little study had been given to the airplane as a weapon to destroy submarines but this was the area where its importance really showed. After sufficient aircraft became available and tactics had been developed for aerial anti-submarine warfare the airplane overshadowed all other methods of destroying submarines.

CHAPTER IV

CAPITAL SHIPS

1. Battleships between the wars.

The battleship was one of the few weapons that had been a major weapon during the First World War. Other weapons which became paramount during Hitler's War had played only minor parts in the 1914 War. True, the submarine had caused a great many casualties but not nearly as many as they contributed during the latter war. Airplanes in tho 1914 War had really been minor weapons as far as naval tactics and strategy were concerned.[1] Mines also contributed to the naval effort of the First World War but were not considered dominent weapons. Therefore the battleship was one of the few naval weapons which was considered important during the earlier war but had lost their importance in the last European war. The tactics of how to use capital ships against other large naval weapons were well understood during the period between the wars, but how these vessels were to be applied during the coming war, considering the new developments in naval technology, was not completely understood.

The battleship according to Mahan's doctrines was the prime weapon of naval warfare. All other vessels existed only so that capital ships could come in contact with their opposite members. This was because Mahan defined the sea as a broad flat plain. In this dofinition the battleship's power was supreme because it could bring the heaviest force to bear. The new developments of aircraft

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[1] Admiral Jellicoe was afraid of the German Zeppelins but they never made an appearance at the Battle of Jutland. During the first war the airplane was too unpredictable to be able to influence naval operations.

and submarines gave these weapons the ability to evade capital ships' force; one through altitude and the other through depth. The new weapons which were not vulnerable to battleships' overwhelming power were both types which were accepted by the Jeune Ecole.

The surface ship of the type which had held command of the seas for centuries was the center of considerable discussion during the period between the wars. Advocates of both air power and submarines expressed their belief that the battleships which had sailed so valiantly into the Battle of Jutland were no longer worth the money. They felt that these immensely and increasingly expensive ships were too vulnerable. The increased cost was shown by the prices for battleships built during the First World War and the ones built between the wars. The battleships Resolution, Revenge, Royal Oak and Royal Sovereign were completed in 1916 and 1917. Their cost was between £2,406,368 and £2,570,504. The battleships Nelson and Rodney were both completed in 1927 and cost respectively £6,410,071 and £6,414,653. The cost of battleships had more than doubled during the ten years after the completion of the latest World War I battleships.[1] Even by 1920 the battle-cruiser Hood, which was for its time an immensely expensive ship, cost £5,698,946.[2] The increasing cost of British battleships was due in large part to the devaluation of the pound and increasing costs of labor. Several destroyers of the Tribal class, costing £467,000 apiece, could be built for the price of one battleship.[3] Not only were battleships increasing in cost because

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[1]Rear-Admiral H. G. Thursfield, Brassey's Naval Annual, 1938, (Hereafter referred to as Brassey's), (London: Willian Clowes), p. 218-9. Francis E. McMurtie, Jane's Fighting Ships, 1941, (Hereafter referred to as Jane's), (New York MacMillan, 1942), lists the cost of the Nelson and Rodney as £7,504,000 and £7,617,000 respectively.

[2]Brassey's, 1938, p. 218.

[3]Jane's, 1941, p. 36.

of changes in the economic situation but they became much more complicated and consequently more expensive. The fire control system for the King George V class battleships in 1912 cost £11,000. For the King George V's in 1939 the cost of the gunnery control was £213,000.[1] Other developments were built into 1918-1939 vintage battleships; radar, anti-aircraft guns, horizontal armor plate, high speed steam turbines, and increased sub-division.

During the First World War the naval staff of England witnessed the rapid destruction of several of their best capital ships at Jutland. Several of the newest British battle-cruisers of the Third Cruiser Squadron were blown out of the water in the opening minutes of the Battle of Jutland. The vulnerability of these vessels, which were then the pride of the British fleet, led to the conclusion that the battleship was vulnerable to its own kind. The public felt that any battleship that was built could easily be destroyed by an opponent's equal. What they failed to realize was that the problem with the British battleships was not that they had outlived their usefulness, but they had been poorly designed. A well conceived ship such as Bismark and Tirpitz showed during the 1939 War that considerable punishment could be absorbed by battleships.

The evidence for the disillusionment with battleships was found in the disarmament conferences of 1921 and 1930. The Washington Naval Conference of 1921 limited only capital ships and this was at the time thought to be sufficient.[2] The battleship was supposed to be an example for the continued disarmament of all types of military weapons. It was chosen because it seemed at first that this would be the one weapon which all the powers could agree to eliminate.

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[1]Brodie, Sea Power in the Machine Age, p. 233.

[2]O'Conner, Perilous Equilibrium, p. 6-7.

Later another conference was called because the naval powers were still constructing large fleets of cruisers and other warships. Roskill in his overall study of sea power noted that Britain, along with the other powers, felt required to build the largest ships allowed by the limitation treaties.[1] This was one of the handicaps of the disarmament conferences. The question of the usefulness of battleships was pointed out by the leading naval power of the inter-war years. In a memorandum issued February 7, 1930, the British government asked for an agreement that would do away with the battleship because they were expensive and of "doubtful utility."[2] This seems to give credence to the view that naval leaders were unsure of the value of battleships. At least one British naval theoretician wanted the complete abandonment of battleships. Sir Herbert Richmond wanted the largest size of surface ship to be limited to 10,000 tons. In his article in the Nineteenth Century he expressed the opinion that large ships were no more protected than smaller ones.[3] This view was wrong, but it was one belief of many about the failure of battleships. He thought that the battleship was no longer necessary for the protection of British commerce and the most effective weapon was a cruiser type weapon.

Another of the limitation treaties was only effective against the defeated powers of the First World War. The Treaty of Versailles limited the size of the German Navy in many ways. One of the limitations placed on it was that they could build no battleships larger than 10,000 tons. Admiral Raeder who was responsible for the rejuvenation of the German Navy pointed out that with this limitation two types of ships could be constructed: (1) a stoutly armored and slow vessel similar

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[1]Roskill, Strategy of Sea Power, p. 146.

[2]O'Conner, Perilous Equilibrium, p. 72-3.

[3]Adm. Herbert Richmond, "The Case Against Big Battleships," Nineteenth Century and After, Vol. 116, August, 1934, p. 189.

to a monitor or (2) a lightly armored ship with high speed and medium guns with a greater versatility of action.[1] During the period between the Treaty of Versailles and the Anglo-German Naval Treaty of 1935 the Germans chose the latter. This gave them the "pocket-battleships" which were troublesome to the Admiralty planning office.

After the Anglo-German Treaty the German Navy was allowed to build up to 35% of the strength of the Royal Navy. Immediately afterwards Germany started construction of a navy including submarines, carriers, and heavy units. This fleet was probably intended to challenge Britain on the sea at a later date than 1939. At any rate the German naval leaders were convinced of the usefulness of battleships in the navy.

It seems that throughout the period between the wars the naval leaders failed to recognize the value and place of the capital ships. It was one of O'Conner's contentions, and seemingly a valid one, that the failure to understand the role of airpower led to the unstable and illusory equilibrium of armaments. He used as evidence for this that in the 1930 Conference carriers were not discussed.[2] The changed role of the battleship was not fully recognized. The battleship during the Second World War was not the prime weapon of naval warfare, but the largest member of the naval team and best suited for leading the attack on its equal.[3] This seems to be the real role of the battleship and it was a mistake on the part of the airpower advocates and the naval leaders not to have recognized the changed situation.

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[1]Grand Admiral Erich Raeder, My Life, Trans. Henry W. Drexel (Annapolis, Maryland: U. S. Naval Institute, 1960), p. 146.

[2]O'Conner, Perilious Equilibrium, p. 76 and p. 118.

[3]Parks, British Battleships, p. 675.

2. Capital ships in defensive actions.

During the Second World War battleships and battle-cruisers were used in a defensive manner mostly by the Allies. Since most of the defensive actions by the British were fleet actions this section tends to be a study in the employment of capital ships in this type of action.[1] The defensive fleet actions by the Allied navies were usually attempts to protect commerce from commerce raiders, or in the Mediterranean from Italian attacks on convoys. Until the surrender of the Italian Fleet in 1943 Allied warships were consistently used in a defensive manner. Even after the Italian defeat, capital ships were still used to protect convoys to Russia.

The one true fleet action was the Battle of Cape Matapan, 28-29 March, 1941. This battle between two major fleets involved both air attacks from British aircraft-carriers and operations with battleships. Losses for the Italians were three cruisers and a number of smaller vessels. In neither case were capital ships damaged beyond repair, and the only reason three cruisers were lost was because one of their comrades was dead in the water and two others were attempting to aid him when suprised by the British battleships. Had these cruisers possessed radar these losses might have been avoided.

In the Atlantic the largest capital ship lost to gunfire alone from another capital ship was Hood (42,100 tons). Hood had sailed out to meet Bismark and Prinz Eugen during their brief sortie into the Atlantic. Accompanying the Hood was one of the new King George V battleships, Prince of Wales. During the brief but sharp action Hood blew up and sank and Prince of Wales was damaged. This action was particularly interesting because it showed the increase of modern

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[1]There was one real fleet action in the Pacific which foreshadowed the Battle of Jutland. During the Battle of Leyte Gulf the American Fleet crossed the 'T' of the Japanese Fleet in Surigao Strait. This battle between capital ships was a crushing defeat for the Japanese.

fire-power and accuracy since the 1914 War. Hood was laid down during the first war and completed in 1920. Officially Hood was classed as a battle-cruiser, which had the same armament as battleships, but armor had been sacrificed for speed. She was deficient in armor protection when compared with Bismark. The latter had been laid down after the Anglo-German Naval Treaty and incorporated the latest improvements in naval architecture. Hood was almost immediately straddled and shortly after the beginning of the action a shell penetrated to the magazines and she blew up, broke in half, and sank.[1] Prince of Wales was just barely out of the builder's yard. Due to mechanical defects she took little part in the proceedings and while being damaged, she managed to inflict some damage on Bismark.

During the long chase that ensued after the sinking of Hood there were many interesting aspects of naval war. Bismark was finally sunk while trying to regain the safety of French waters. In this operation, units from both Home Fleet and Force H from Gibraltar took part and damage which allowed the pursuers to

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[1]Admiral Holland, commanding the task force sent out after Bismark, certainly knew the liabilities of his ships. But, it seems to this author that even though his plan took into consideration these disadvantages a more effective tactical operation was possible. Holland failed to make use of his three advantages; numerical superiority, superior speed in one of his major ships (the Hood was officially a little less than two knots faster than Bismark), and a relatively new untried ship. According to Oscar Parks', British Battleships, p. 678 the Hood's protection increased because of the vertical armor as the range decreased from 12,000 yards. The Prince of Wales was safe from heavy guns down to 13,000 yards. Holland approached at a small angle from behind. It seems that it would have been better had the two shadowing cruisers joined tne battle and engaged the Prinze Eugen. The Prince of Wales could have then engaged Bismark at extreme ranges until Hood gained a position in front of the Bismark. Once the Hood had gained such a position it could have closed head on at a closing rate of 60 knots and presenting a very difficult target until the range was under 12,000 yards. As it was the first salvo was at 26,500 yards and the last at 14,600 yards and the Hood never achieved its maximum protection.

atch up was caused by a torpedo from the Fleet Air Arm. After Bismark had isappeared an airplane spotted it and reported its position to the British units.

The ability of Bismark to absorb punishment from surface vessels and other eans of attack was phenomenal. Over ninety torpedoes were launched by various eans; eight struck home in various places. Further about 2,900 shells were ired at Bismark of which about 700 were either fourteen or sixteen inches in iameter. The information about the number of hits was not available but it an be assumed that most of them struck home because during the final minutes f the battle the British battleships were firing at virtually point-blank range. robably more important to her survival was that of the eight torpedo hits; four ere in each side which tended to keep her trimmed on an even keel.[1]

The action during the sortie of the German ships involved only two ships, ismark and Prinz Eugen, on the Axis side. From the Axis standpoint it was oubtful if this was a fleet action. The British action on the other hand was ertainly a fleet action; involving the capital ships Hood, Prince of Wales, ing George V, Rodney; the aircraft carriers Victorious and Ark Royal; the ruisers Doresetshire, Norfolk, Suffolk; and a number of destroyers. All this ffort simply for the destruction of one ship showed the threat that this battle-hip posed to the lifeline of the British Empire, commerce.

Another action involving capital ships was the damaging of the Graf Spee ff the coast of South America and her final scuttling. This German vessel was loser to a heavy cruiser, but since her generic name, pocket-battleship, in-luded the term battleship, she has been included in this section rather than nother. The pocket-battleships--which were called by the Germans Panzerschiff

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[1]Korotkin, Battle Damage to Surface Ships, p. 176-185.

or "armored ships"--were a new and radical design of surface warships. Mounting six, eleven inch guns they had diesel engines for long cruising ranges and steam for battle speeds.[1] Three of these ships, Graf Spee, Scheer, and Deutschland (later Lutzow) were built during the period from 1928 to 1939. The principle behind their construction was that they could out-gun anything they could not out-run and out-run anything they could not out-gun. This theory did not hold up in practice because the British battle-cruisers Hood, Repulse and Renown all had superior speed and armaments. The most reliable sources said that the pocket-battleships could do 28 knots. The British battleships while had probably lost some of their speed because of age did 31.45 knots on their trials. Nor were the German pocket-battleships superior in either speed or armament to the French battleships Dunkerque and Strasborg. Other than the above mentioned ships the pocket-battleships exceeded either in speed or armament all other Allied warships. Their long cruising radius made them supposedly ideal as commerce raiders.

While on a commerce raiding operation Graf Spee met the British heavy cruiser Exeter and the light cruisers Ajax and Achilles. After a running gun battle with the cruisers, Graf Spee put into Montivedeo and after remaining for three days the crew scuttled her in the River Plate. In this action Exeter, the heaviest of the British ships, suffered extensive damage while the other two ships were only slightly damaged. This action, whereby Graf Spee was forced to scuttle, seemed to show that perhaps the German Naval Staff was correct in their idea that the pocket-battleships were superior to any single Allied warship except those already mentioned. The other pocket-battleships were sunk in port by attacks by the Royal Air Force in 1945.

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[1]Erich Groner, Die Schiffe Der Deutschen Kriegsmarine und Luftwaffe, (Munchen: J. F. Lehamanns Verlag, 1954), p. 70.

The last of the major warships lost because of an action against it by more than one type of vessel was the German battleship Scharnhorst. Famous for her Channel dash, she was set upon by several cruisers and destroyers and the battleship Duke of York off the coast of Norway. With her radar out of action Scharnhorst had difficulties firing at British warships during the Arctic night. Due to several torpedo attacks launched by the Allied destroyers the superior speed of the German battle-cruiser was lowered until the British battleship's heavier guns could be brought to bear.[1] After suffering fifteen shell hits (eight and fourteen inch shells) and six torpedo hits the Scharnhorst sank on the night of 26 December, 1943.

During the war in the Mediterranean no Italian battleships or battle-cruisers were lost because of surface actions with an Allied fleet. Several Italian cruisers and destroyers were lost but these will be dealt with in a later section.

No other British battleships were lost because of gunfire than the already mentioned Hood. Two Allied battleships were lost in the Atlantic because of submarine attacks and two more because of special operations in Alexandria.

The age of the battleship had passed by the Second World War. Only in the Mediterranean did two fleets meet and neither side lost any capital ships in these actions. The losses of battleships and battle-cruisers on both sides were what could be called either task force operations or small weapon attacks. These actions were not small in the size of the ships involved but small in the number of ships participating in the action. Most cases were decided by only one ship being lost. The only exception to the studies made in this short segment on

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[1]It seems that in heavy Arctic seas the Scharnhorst should have been able to outrun the lighter destroyers which delivered the torpedo attacks. Edgar March, British Destroyers, p. 406 noted that on their respective trials the Scharnhorst was only half a knot slower than the destroyers but at least one destroyer, Saumarez, exceeded its trial speed.

battleships was during the actions between the German ships Bismark and Prinz Eugen and the British ships Hood and Prince of Wales. Yet, by the time the overwhelming forces of the British had caught up with the Bismark, Prinz Eugen had escaped.

The conclusion derived was that the battleship was still an effective weapon to destroy other battleships. But during the war other means were perfected which were effective in sinking capital ships. During the Second World War the battleship changed from virtually the only weapon of naval warfare to the heaviest member of the team.

3. Capital ships in offensive actions.

The offensive capabilities of the capital ship was of two types. One method was of vital importance to the naval war; commerce raiding. The other method was more important to the land war, shore bombardment.

The German Navy spent a great deal of effort developing commerce raiders during the period between the wars. Before the treaty with Britain which allowed them to start construction of a fleet, the emphasis in capital ship production was on the pocket-battleship. Any belief that Graf Spee and her sister ships were built purely for the protection of the Baltic and perhaps operations in the North Sea was disproved by their cruising radius. Equipped with diesel engines they had sufficient range to allow them to remain at sea in far distant areas for long periods of time. The major warships built after the signing of the Anglo-German Naval Treaty were generally of the usual type with shorter ranges and greater fighting power. This was the common type of battleship as differed from the radical pocket-battleships. They were characterized by Tirpitz and Bismark.

Once again whether this was the correct application of capital ships hinges on the question of how much damage did they do the Allied supply system. During

the war in the Atlantic the surface raiders Scharnhorst, Gneisenau, Graf Spee, Deutschland, Scheer, and Hipper sank forty-four ships which totaled 270,859 tons.[1] This figure while seemingly large in no way compared to the over seven million tons of British shipping sunk by submarines. The interesting thing to note about the losses of merchant ships was that very few of them were small ships which proved that the surface raiders could be selective in the ships which they sank. Partially the explanation that few small ships were sunk was that they usually plied their trade in shallow waters close to shore where a radio warning would have brought instant retaliation to the attacker. When ships were met during the break out into the Atlantic, they were avoided as swiftly as possible.

In order to protect the shipping from German commerce raiders, battleships were used as escort for important convoys when there was a threat of German surface actions. One aspect of convoy operation was that until the warship was either sunk or had returned to port the convoy system stopped. This incredibly complicated system came to a virtual halt because in a few minutes a powerful surface raider could destroy large numbers of ships. Because of the pocket-battleship Scheer's attack on the convoy from Halifax, HX 84, in which the armed merchant cruiser Jervis Bay was sunk defending the convoy, the system was stopped for nearly two weeks. This stoppage, according to Roskill, caused more damage than the actual number of ships sunk by Scheer.[2] If the convoy system was stopped for some time by warships it might have been difficult to get it started again. The ports which were supposed to be empty so another convoy could start forming would not have

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[1]Admiralty, British Merchant Vessels Lost. This listing includes the losses caused by the German cruiser Hipper. While not actually a capital ship because she engaged in commerce raiding she has been included as causing part of the losses.

[2]Roskill, War at Sea, Vol. I, p. 289.

been empty and a massive pile up could have developed. Other ports or anchorages could have been used as temporary measures but the complications of this would have multiplied rapidly.

The raiders when they did go into the ocean found it highly dangerous as a rule to attack convoys. First, when a convoy was attacked their position was certain to be reported by the escort. Second, if the escort was not too weak the raider might have suffered damage and not have been able to return to port. The best possible place for the warships was the convoys. If the escort was dealt with satisfactorily large numbers of merchant ships could have been sunk in a few minutes. After the sinking of the Graf Spee early in the war, the raiders had strict orders never to attack heavily escorted convoys. The use of Scharnhorst and Gneisenau, according to Woodward, to attack single merchantmen during the war was not worth the effort. Woodward was referring to the time when the two battle-cruisers came upon a convoy escorted by the old battleship Ramillies. This British battleship was completed during the First World War and was armed with eight, fifteen inch guns. She might not have been a match for the two modern and considerably faster German battle-cruisers. Gneisenau was apparently maneuvering to engage Ramillies when Admiral Lutjens, who later commanded Bismark force, ordered a withdrawal.[1] David Woodward forgot to recognize that part of the task of battle-cruisers was to insure their continued existence. Germany did not have many major warships and the chance of damage to the Scharnhorst and Gneisenau was too great. Ramillies with fifteen inch guns versus eleven inch for the battle-cruisers was practically guaranteed to cause

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[1]Woodward, Tirpitz, p. 50. For the story of the Scharnhorst's and Gneisenau's commerce raiding activities see Philip Lundeberg, "The Scharnhorst-Gneisenau Team at its Peak," USNIP, August, 1956, p. 852-860.

some damage. The heavier armor plate also gave the British ship added advantages. If one of the hits on the battle-cruisers was in a vital area which would have either stopped the ships or slowed them considerably they almost certainly would have been lost. Also, their task was not to attack battleships but to sink merchantmen and they might have been jeopardizing their mission.

The surface ships as commerce raiders had the ability to draw off large numbers of British capital ships much as did the capital ships as "fleets in being." Examples of this were the large numbers of task forces that were patrolling the oceans in order to catch Graf Spee and Deutschland. And while battleships were necessary to protect certain convoys--such as troop transports--they could have been well employed elsewhere.

Commerce raiding battleships caused more havoc than was justified by the number of ships that they sank. Perhaps if the Allies had not been so powerful in capital ships they might have caused more damage. This was pure speculation because the capital ships did not sink a large number of ships.

4. Capital ships as "fleets in being."

A battleship when used as a fleet in being was neither offensive nor defensive but just a method of tying down large amounts of force. A fleet in being's main purpose was to tie down forces so that other means of attack could achieve success. In this operation the ships seldom sailed but remained in port threatening the commerce routes and sailing only from time to time to keep their presence remembered.

Perhaps the effect of large battleships used in this method of employment was shown by the sister ship of Bismark, Tirpitz. Of nearly 42,000 tons, this battleship caused the Allies untold effort and worry until she was sunk in November of 1944. Yet, the most remarkable fact was that this warship never fired her

main armament at an Allied warship. Upon completion she remained in various fjords in Norway where her presence was enough of a threat to make the Allies keep strong forces in waters close by when they were urgently needed elsewhere. Had tho British Navy been able to remove the covering forces from the convoys to Russia the battle for the supremacy of tho Mediterranean would have been settles much easier. Tirpitz's position in Norway caused hor to be a serious threat on the flank of the convoys carrying supplies to Russia. Heavy covering forces always accompanied these convoys when there was a chance that the battleship would attack them. It was hoped that they would be able to protect the convoys from Tirpitz and even better the German battleship would have been sunk. The two convoys, PQ 15 (to Russia) and QP 11 (from Russia), had as escorts the battleships HMS King George V, and USS Washington, the aircraft carrier HMS Victorious, one British and two American cruisers and ten destroyers.[1] These warships were sent to protect tho two convoys in the latter half of April, 1942. This was when the threat in the Mediterranean reached its height and American warships were desperately needed in the Pacific to stop the advance of the Japanese Navy. Yet, Tirpitz never weighed its anchor during the passage of this pair of convoys.

Other vessels of the German Navy played the same role as the Tirpitz, including the battle-cruiser Scharnhorst, the pocket-battleships Scheer and Lutzow, and tho heavy cruisers Prinz Eugen and Hipper. These vessels, which were in serious danger on the open sea, caused on the other hand innumerable air attacks to be launched against them and the retention of superior forces when they could have been more profitably employed elsewhere.

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[1]Woodward, The Tirpitz, p. 83.

The Italian forces in the Mediterranean might have been similarly employed as their German counterparts. At times they had enough battleships to challenge the British movements in the central basin of the Mediterranean. By allowing the fleet to remain in port when there were ample opportunities to score a decisive victory and gain control of the convoy routes to Africa showed that they were something less than a fleet in being; they were an unused fleet. It is quite noticeable that the German ships have been called by name partially because there were so few that given a normal war-time situation they did not constitute a fleet. The Italians on the other hand had several battleships, including the new and modern Littorio and Vittorio Vento. Where it seemed that the failure to employ the Italian fleet in offensive operations was a failure to use its forces; the failure to use the German warships was an economy effort directed by the necessity of not losing the few ships they did have.

There can be some question of the usefulness of the German heavy forces as fleets in being. It was dangerous for the warships to sail and they took little part in the operations. At the same time they occupied large numbers of men and material. In a report presented by the Quartermaster Division of the German Naval Staff to Hitler it was cited that by scrapping the warships left to the German Navy in 1943 over 125,000 tons of steel and nearly 9,000 trained officers and men would have been gained.[1] Over 125,000 tons of steel would have been an addition to the German war economy and nearly 9,000 men would have been able to make crews for 180 Type VII C submarines.[2]

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[1] Fuehrer Conferences, 1943, Report presented by the Naval Staff, Quartermaster Division concerning the dismantling of the battleships Tirpitz, Scharnhorst, Gneisenau, and the heavy cruisers Hipper, Prinze Eugen, Admiral Scheer, and Lutzow, 2 January, 1943, p. 5.

[2] Roskill, War at Sea, Vol. II, p. 475 stated that this type of submarine required a crew of forty-four. This divided in 9,000 more than 180 times but it was doubtful if the crews for 180 submarines could be gained from the crews of the battleships. This example has been used only to accent what might have been possible.

The question of whether fleets in being were more valuable remaining in action or being scrapped depended on the amount of effort and confusion they required the enemy to exert. Both Admiral Raeder and Doenitz argued for their retention while Hitler wished to have them cut up and used for scrap. A formula can be derived which shows whether or not the surface ships should have been retained. Such a formula is:

AXIS

$$\frac{\text{Amount of effort required to support and operate surface craft}}{\text{Amount of material gained by scrapping surface craft}}$$

VS.

ALLIES

$$\frac{\text{Amount of effort required to contain surface craft}}{\text{Added effort needed elsewhere because of increased material}}$$

The difficulty of this formula was that there were no objective units of measurment. If the figures on the left hand side of the formula exceeded the figures on the right, then the surface craft should have been destroyed. On the other hand, if the figures on the right exceeded those on the left, the surface craft should have been retained. The figures do not exist which would allow this formula to be implemented. No one has determined how many more destroyers would have been necessary to restrict the extra number of submarines gained because of the scrapping of the battleships. Using hindsight, it can be determined that the battleships were valuable to the Germans because the British were expending considerable amounts of effort trying to destroy them. The air attacks on Tirpitz, small as they were compared to the strategic raids, absorbed some of the Allied air power. More important was the need to keep three battleships in the home

fleet.[1] Not only were the crews, fuel and munitions for the battleships necessary but also destroyers were required to be in constant readiness and could not be released for convoy duty.

Not only was the amount of effort required for surface ships difficult, if not impossible, to determine, but it was equally difficult to determine the losses suffered because of the presence of the battleships. The German ships in Norway sometimes made the attack of other weapons easier. Convoy PQ 17 (to Russia) was ordered to scatter because of the threat of German surface ships which never made contact. Since the escort was removed and the ships were in ones and twos the German Air Force and submarines had a great number of successes, 200,000 tons of supplies and 21 ships were lost from this one convoy by means other than surface attack.[2] Certainly some losses would have been suffered by this convoy but the withdrawal of the escorts and the scattering of the convoy made the individual merchantmen much more vulnerable to attack by aircraft and submarines.

It seemed that because of the effort required to contain the German warships in Norway the Allied forces greatly exceeded the necessary German effort to supply the warships. Warships, which were not integrated with a fleet but few in number and opposed by greatly superior forces, caused serious dislocations and losses out of proportion to their number.

5. The influence of battleships during the Second World War.

The capital ship had one use which has only been mentioned in this section; its power for shore bombardment was unequaled by any other weapon. During the period before 1943 and the surrender of Italy, battleships were a scarce commodity

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[1]Woodward, The Tirpitz, p. 86.

[2]Ibid., p. 93.

and necessary for the command of the sea. After the Italian Fleet surrendered during the summer of 1943 the capital ships which had been used to contain them were no longer needed. There was a surplus of Allied battleships after this period and they could now be used for the more dangerous task of shore bombardment.[1] This use of battleships for primarily land work shows one of the main influences of naval power. While the war may not yet have been won the command of the sea had relinquished its importance and it was now time for the army to conquer the territory and force the enemy to surrender.

The battleship during the Second World War still had valuable tasks to perform. Its prime task was the destruction or containment of enemy battleships. It was no longer the only weapon which could perform this task but the largest member of the naval team engaged in protecting the sea lanes. While it could not defend the sea lanes from submarines and mines, and aircraft only in a limited sence, they still could destroy surface ships and protect the sea lanes from them.

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[1]Bernard Brodie, A Guide to Naval Strategy, (New York: Frederick A. Praeger, 1965), p. 76.

CHAPTER V

OTHER SURFACE WARSHIPS

1. Cruisers during the period between the wars.

Edward Altham in the article "Cruiser" in the Britannica said the cruisers' functions were to guard the sea routes and to act as the advance guards of the fleet.[1] During peacetime the cruiser had a duty which was not particularly important during wartime. This was showing the flag throughout various ports and harbors of foreign nations. During the period between the wars some naval thinkers proposed that the British Navy concentrate on cruisers and neglect the battleship.

During the period of the naval limitation treaties, 1922-1936, cruisers were subject to nearly as much discussion as battleships. The prime question between the wars was whether large cruisers as the London and Norfolk class of 9,759 tons and 9,900 tons respectively were the most practical.[2] Larger cruisers generally possessed heavier armament but little armor protection. They were built by Britain in an effort to compete with the large American cruisers being built at the time. Generally the American cruisers displaced 9,000 tons.[3] American cruisers were built to operate in the Pacific where distances were considerably greater than those in the Atlantic. These new cruisers, laid down between 1929 and 1930, cost nearly as much as a World War I battleship. Queen Elizabeth, Resolution, Revenge,

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[1]Capt. Edward Altham, "Cruiser," Encyclopaedia Britannica, Vol. 6, (Chicago: Encyclopaedia Britannica, Inc., 1943), p. 768.

[2]Brassey's, 1935, p. 219. Brassey's, 1938, p. 223 lists the cruisers somewhat larger.

[3]Ibid., 1938, p. 256-8.

Royal Oak and Royal Sovereign cost between £2,204,368 and £2,570,504. Devonshire cost £2,007,275 and Doresetshire £2,101,951.[1] These cruisers during the last European war were not particularly useful and may have been a waste of money and effort.

Seventy cruisers were considered necessary for the maintenance of British naval strength but Admiral Beatty (who had led the battle-cruisers at Jutland) supported Churchill's desire for fewer, larger cruisers; consequently larger ships, but smaller in number, were accepted.[2]

The bickering between the powers over cruisers led generally to nothing. Each of the powers engaged in the naval conferences was primarily interested in their own naval needs. After the reconstruction of the German Navy and the development of the pocket-battleships the need in Britain was not for large lightly armored cruisers, but for ships which could protect the sea lanes and have the gun power and armor to do battle with the more heavily armed German warships. British cruisers needed less range and speed and more gun power and heavier armor to deal with pocket-battleships. The eight, 8-inch guns of the London class cruisers threw a projectile weighing 256 pounds for a total broadside of 2,048 pounds. The German pocket-battleships had six, 11-inch guns, each hurling a shell weighing 670 pounds for a total broadside of 4,020 pounds.[3] It took nearly two British heavy cruisers to equal one of the German commerce raiders in gun power alone. Brassey's Naval Annual does not list the armor protection of the

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[1] Ibid., 1935, p. 219, and Higham, Armed Forces, p. 131.

[2] Higham, Armed Forces, p. 128.

[3] Brassey's, 1938, p. 318, 327.

London class cruisers but according to Higham the new cruisers were relatively unarmored.[1] Since obviously the German pocket-battleships were designed to raid commerce it would have been more logical for heavier armed and armored cruisers, even though somewhat smaller, to have been built for protecting convoys.

Admiral Sir Herbert Richmond was one of the prime advocates of cruisers. He felt for the defense of British shipping, vessels which were able to patrol the lanes, even in the most distant areas were needed. Richmond like so many other military authors tended to ignore the threat from German submarines. This seemed somewhat unusual because during his earlier years he belonged to what might be called the liberal school of the navy. He graduated from the torpedo school HMS Vernon in 1897 and was a member of the "fishpond."[2] Richmond wanted a ship with a displacement of 10,000 tons, capable of speeds up to 28 knots, and at 15 knots could have cruised 8,000 miles.[3] This was satisfactory for operations in the Channel and North Sea but during the war failed to exert satisfactory influence.

During the war with Hitler cruisers were distinctly neglected. Few battles involving them are well known today and as a class they have been nearly forgotten. Usually cruisers when engaging German warships were only participating in a delaying action until battleships could catch up. Few of the cruisers had the fame and glory of the battleships because their larger brethern were considered to have been the cause of victory. The part Prinz Eugen played during the sortie of

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[1]Higham, Armed Forces, p. 127.

[2]D. M. Shurman, The Education of a Navy: The Development of British Naval Strategic Thought, 1897-1914, (Chicago: University of Chicago Press, 1965), p. 111 and 122.

[3]Higham, Military Intellectuals, p. 34-5.

Bismark has been ignored by most historians, as was the role of the cruisers shadowing the Bismark. As a class they have not nearly the fame as destroyers which can, with some justification, be held to have won the Battle of the Atlantic. Few major actions involving cruisers were mentioned and it seems that surely more emphasis and information is available than has yet been published. As a general statement it can be assumed that the cruiser operations were for a large part similar in nature, and diminished in size, to those of battleships. The one exception to this was the cruisers were used as scouts for the fleet, and battleships never were because they were part of the fleet itself.

2. Defensive operations with cruisers.

The most famous battle of cruisers during the war was the elimination of the Graf Spee in the mouth of the River Plate. This pocket-battleship had made its break into mid-ocean before the declaration of hostilities and until she was sunk raided commerce shipping in the South Atlantic and Indian Oceans. While hunting for a heavy concentration of shipping off the South American coast she came across the British heavy cruiser Exeter--somewhat smaller than the London class cruisers and armed with six, 8-inch guns--and the light cruisers Achilles and Ajax.

The British cruisers were out gunned by their superior opponent but it was necessary for the Graf Spee to put into Montivedeo in order to make repairs. During the period that the Graf Spee was undergoing repairs the Admiralty rushed forces to the area to prevent her escape. Because of the damage received, Exeter was replaced by the heavy cruiser Cumberland. Rather than face the fire of the British cruisers again the captain of the Graf Spee scuttled his ship.[1] Certainly

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[1]S. D. Waters, New Zealand in the Second World War, Vol. I, no. 4, "Achilles at the River Plate," (Wellington, New Zealand: War Historical Branch, Department of Internal Affairs, 1948).

The Graf Spee lost the battle but she was not damaged to the point that she could not have inflicted more damage to the British cruisers. Because Captain Langsdorff realized the fight was hopeless he decided to save his men. This battle pointed out one disadvantage of the German position. The British ships when damaged could put into a number of ports and remain until the damage had been corrected; the Germans could not.

In several other operations in the Atlantic cruisers played secondary roles in the defense of merchant shipping. Three different cruisers participated at one time or another in the events that led to the destruction of Bismark. Four cruisers took part in the sinking of the battle-cruiser Scharnhorst. These operations were the only time that cruisers were within gunnery range when a major warship was sunk in the Atlantic. In all these operations a major Allied ship was present and caused more destruction than the cruisers. But the sinking of Bismark showed one of the cruiser's main advantages and perhaps its primary task. The cruiser with its longer range could and was used as a means of reconnaissance. In the case of Bismark it was cruisers that found her and managed to shadow her until the British fleet caught up. In the sinking of Graf Spee the cruisers were patrolling a certain area in hopes of catching her and if unable to destroy the Graf Spee would have shadowed her until heavier fleet units caught up.

3. Cruisers in offensive actions.

Only one of the German heavy cruisers, Hipper, attacked commerce in the Atlantic. At this job she was not particularly successful; because of defects in her engines she caused few losses before being forced to return to port. The other German cruisers Blucher and Prinz Eugen, played minor roles in the Atlantic. Blucher was sunk by Norwegian shore batteries and torpedoes during the surprise

attack on Norway in 1940. And Prinz Eugen, which survived the war, was famous only for operations in which she took part; with Bismark during her brief foray into the Atlantic and with Scharnhorst and Gneisenau during their dash up the English Channel.

While not exactly offensive operations the war in the Mediterranean showed another use of cruisers. During operations in the Mediterranean cruisers were used most often to escort convoys. This was due partially to the threat from aircraft. While the battleships Nelson and Rodney had eight and six, 4.7-inch anti-aircraft guns, respectively, on their original designs, the cruisers Devonshire and Doresetshire while being less than a third the size of the battleships had eight, 4-inch anti-aircraft guns each.[1] If multiplied times three they would have had 24 anti-aircraft guns as compared with the battleships which had either six or eight.

In the Mediterranean three cruisers were lost in a matter of minutes when they were approached by British battleships. During the Battle of Cape Matapan (March, 1941) the Italian cruisers Fiume, Zara and Pola were lost primarily because of Warspite's fifteen inch guns. This one action accounted for 25% of the twelve Italian cruisers lost during the war. Four Italian cruisers (San Giorgia, January, 1941; Attendolo, December, 1942; Trieste, April, 1943; Bari, June, 1943) were lost because of air attack, one cruiser (Trento, June, 1942) was lost by a combination of air attack and submarine, one cruiser (Ulpio Traino, January, 1943) was lost because of human torpedo, and the remaining three (Colleoni, July, 1940; Da Barbiano, December, 1941; and Di Guissano, December, 1941) were lost because of surface action at various places in the Mediterranean.[2]

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[1] Brassey's, 1938, p. 218-219.

[2] Roskill, War at Sea, Vol. III, pt. 2, p. 379.

The British Mediterranean cruiser losses were all from weapons of Jeune Ecole. Eight British cruisers (Calypso, June, 1940; Bonaventure, March, 1941; Dunedin, November, 1941; Galatea, December, 1941; Naiad, March, 1942; Edinburgh, May, 1942; Hermoine, June, 1942; Penelope, February, 1944) were lost because of submarine attack; six because of air attack (Southampton, January, 1941; Fiji, May, 1941; Glouchester, May, 1941; York, May, 1941; Trinidad, May, 1942; Spartan, January, 1944); one because of mine (Neptune, December, 1941); and two because of E-boat torpedoes (Manchester, August, 1942 and Charybids, October, 1943).[1]

4. Cruisers during the war.

The majority of the cruisers lost in both the Atlantic and Mediterranean were sunk because of underwater explosions. Of the nineteen British cruisers lost in either the Atlantic or the Mediterranean Theaters, eleven were lost because of torpedoes or mines. The British losses were as follows: one (Effingham) struck a submerged rock, eight (Calypso, Bonaventure, Galatea, Naiad, Hermoine, Dunedin, Edinburgh, Penelope) because of submarines, six (Southampton, Fiji, Gloucester, York, Trinidad, Spartan) because of aerial attack, two (Charybids, Manchester) because of E-boat torpedoes, one (Neptune) because of mine, and one (Dragon) because of human torpedo.[2] Fourteen of the British cruisers lost were sunk because of damage below the water line. Because of the necessity of using cruisers for convoy escorts, evacuation ships, shore bombardment, and commerce raiders in the Mediterranean, the losses were correspondingly higher than losses in the Atlantic. Five of the British losses were in the Atlantic and one of those was by accident. Korotkin, in his work on damage to surface ships, stated that

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[1]Admiralty, Ships of the Royal Navy.

[2]Ibid.

two-thirds of the cruisers lost (in both the Pacific and Atlantic) were lost because of underwater explosions, a figure he derived by adding torpedo losses, mine losses, and aerial bombs, some of which exploded underwater.[1] Further he noted that more cruisers sank from underwater explosions than remained afloat. The last argument was the most telling argument against the continued use of cruisers. The World War II cruisers were unable to withstand the heavy caliber shells of modern battleships; witness the destruction of three Italian cruisers by Warspite's guns and the severe damage to the Exeter caused by Graf Spee's guns. At the same time cruisers could not compete with their own kind because where there were cruisers there were usually battleships. The cruiser was of little value for the protection of convoys because it was vulnerable to the main commerce raiders and had no means of attacking submarines. The only apparent value of the cruiser was driving off attacks of aircraft, but in this section only those cruisers built to engage in surface actions have been mentioned and the cruisers especially developed for anti-aircraft work were much more effective. It was argued during the period of the naval conferences that cruisers were needed to protect British commerce but as the matter turned out it was not cruisers that were needed, but destroyers.

5. Escorts during the period between the wars.[2]

During the period before the Second World War a number of mistakes were made concerning escorts and their effectiveness. The first of these was the

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[1]Korotkin, Battle Damage, p. 296.

[2]The term escort throughout this chapter will include destroyers, corvettes, frigates, sloops, trawlers, coast guard cutters, sub-chasers, and other small vessels used primarily as anti-submarine ships. When it has been necessary to denote some special characteristic of these vessels they will be called by their real name and not just destroyers as a general class.

thought that submarines as commerce raiders had been effectively limited by diplomatic agreements and particularly the condemnation of the German First World War submarine effort. It was assumed that submarines would act in the same manner as surface vessels. Submarines were supposed to surface, signal the vessel to stop, search the ship for contraband and if it then had such contraband sink it after having placed its crew in a safe position. Such a method of operation would have made submarines extremely vulnerable. Even a merchant ship mounting one, four-inch gun could either puncture the submarine's pressure hull or ram it and cause it to sink. Nevertheless some members of the naval staffs believed that the submarine would operate according to the standards established.

In part the problems arose from the fact that the Admiralty was comparatively uninterested in the tactics and strategy of using submarines as commerce raiders.[1] The leaders of the naval staff in Britain were concerned about how they were going to combat the German pocket-battleships. Hector Bywater, who was a prescient observer of naval affairs, noted in 1935 that the pocket-battleships were "a thorn in the side of the British naval staff."[2] Some developments in submarines led the Admiralty to believe that the tactics for submarines would be similar to the rules laid down. The French submarine Surcouf mounted two, eight-inch guns and with such heavy armament it was hoped would be able to do battle as a surface raider, but Jane's in 1941 described it as an experiment not likely to be repeated.[3] The British also built the X-1 with a similar purpose in mind but it too was a failure.

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[1]Robertson, Walker, R. N., p. 23.

[2]Hecter C. Bywater, "The German Naval Renaissance," Nineteenth Century, Vol. 118, July, 1935, p. 46.

[3]Jane's, 1941, p. 184.

The Admiralty made a serious error in the development of methods to attack submarines. During the period between the wars a great deal of faith was placed in the ability of asdic to detect submarines.[1] This device, known to Americans as sonar, sent out a sound beam which bounced off submarines and returned to the sender. In this method submerged submarines could be located and attacked. The problem arose when it was discovered that the Admiralty was only partially correct in their interpretation of how submarines would operate in the next war. Admiral Doenitz and other members of the U-boat arm realized that the submarine was most effective when delivering attacks on the surface, where they could not be detected.[2] Part of the agreements stated that the submarines must surface before attacking a merchant ship. Since the submarine cast such a low silhouette and was much more maneuverable and faster on the surface, their standard attack practice was for the submarines to attack on the surface during the night without warning. The asdic operation worked only on submerged submarines.[3] Asdic during the war turned out to be a very effective method of locating submarines once other means had been used to force them to submerge. But on the surface the detection of submarines was, until radar was developed, a matter of eyesight.

Another problem with asdic was its effective range. Edgar March, who wrote the definitive history of British destroyers, said the furthest detection of a submarine with asdic was at 15 knots 3,300 yards and at 20 knots 2,700 yards.[4] These figures were under ideal conditions. Most submarine attacks were at ranges

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[1]Robert E. Kuenne, The Attack Submarine: A Study in Strategy, (New Haven: Yale University Press, 1965), p. 5.

[2]Doenitz, Ten Years and Twenty Days, p. 4.

[3]Commander D. A. Rayner, Escort: The Battle of the Atlantic, (London: William Kimber, 1955), p. 74.

[4]March, British Destroyers, p. 456.

under 2,700 yards but even slow moving escorts would have had difficulty picking up an unlocated submarine at the shorter ranges. These figures, while probably quite valid, were unrealistic under war conditions.

Like so many other vessels the escorts were unprepared to deal with air attacks. During operations in Norway the importance of sufficient air protection was suddenly and dramatically brought home to destroyer commanders. Admiral Pugsley has noted that the destroyer's main 4.7-inch armament was totally unsuited against German dive bombers because they could not elevate above forty degrees. The only other anti-aircraft armament that the destroyer possessed was two, 0.5-inch machine guns and one pom-pom.[1] Because of the lack of anti-aircraft weapons, which were ignored throughout the period before the war, destroyers were very vulnerable to aircraft when working close to enemy held waters.

6. Escorts in defensive actions.

When the war opened in 1939, the liner Athena was sunk without warning by a German submarine. It did not take the Admiralty long to realize that the merchant ships were going to have to be convoyed. The only satisfactory vessels for convoy duty during the early days of the war were destroyers and there were all too few of these. The convoy was a tactic with a single purpose; to get merchant ships safely through to England. The problem arose when arguments broke out whether this was the most effective means of protecting merchantmen.

The argument was over two questions: (1) whether convoys would concentrate shipping so that large numbers could be sunk in short order, and (2) the losses inherent because of the convoy system. Even though the Admiralty was quick to realize the potential of convoys as a means to combat commerce raiders, members

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[1]Pugsley, Destroyer Man, p. 33.

of the naval staff were reluctant to employ them during the opening months of World War II.[1] Convoys were imposed on the slower ships early in the war but some unwillingness was shown in making them effective for all vessels. There were some valid reasons for looking on convoys with disfavor. The primary reason was convoys caused delays in shipping and unloading. This caused serious congestion in ports and other facilities. According to Behrens, importing capacity was reduced by 20-25% because of delays caused by the convoy system.[2] The figures of shipping for the British Empire in June, 1934, were 20,841,218 gross tons. Because of the convoy system, the services of between 4,168,436 and 5,510,204 gross tons of shipping were lost to the British war effort.[3] These high losses of importing capacity because of the convoy system could only be tolerated on two conditions. First it was necessary that the war be a long one. If it seemed to naval planners that the war was going to last only a short while the absolute losses because of enemy action probably would not have exceeded the losses in shipping capacity caused by the establishment of the convoy system. The second condition was that the enemy had to have available means to attack commerce shipping and cause serious damage. If for example, the war was going to last ten years and losses of 10,000 tons per year were expected there would have been little reason to establish a convoy system. Also if the war was only going to last a year and a million tons of independently routed shipping would have been lost during the year there would have been no reason to employ convoys. But if, as it did, it look like the war was going to last a number of years and the

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[1]E. M. Potter and Chester W. Nimitz, The Great Sea War, (Englewoods Cliffs, New Jersey: Prentice-Hall Inc., Co., 1960), p. 3.

[2]C. B. A. Behrens, Merchant Shipping and the Demands of War, (London: HMSO, 1955), p. 51.

[3]Brassey's, 1935, p. 319.

losses were going to be heavy each year, then the convoy system would insure that enough ships would be available for the long haul. After the sudden fall of France it was obvious that the defeat of Germany was going to take a considerable amount of effort and that to maintain the fighting capacity of the British Isles it was necessary to institute convoys.

Captain Roskill in an article arguing for the use of convoys pointed out that the losses suffered from convoys were considerably less than with independently routed ships. The losses from unescorted ships made up 72% of the losses caused by U-boats; the other 28% were ships in convoy. Also, he noted that greater losses were suffered by submarines in attempting to attack convoys.[1] Although some ships, particularly fast ones, were routed independently, the average merchant ships needed to be defended by convoys. Important ships were routed independently because it was felt that their high speed would allow them to avoid submarines, where convoys would have slowed them down and made their chances of being torpedoed about the same as the average merchant ship. If the high speed vessels were unable to avoid submarines altogether their speed might allow them to zig-zag sufficiently to keep the submarine from attaining an attack position.

The importance of convoys can be graphically illustrated by comparing charts V-2 and V-3. Chart V-2 shows the shipping of the British Empire on a normal day before the war. Chart V-3 shows the position of convoys during a normal day when the convoy system was in full swing. Since, as will be discussed later, the submarines had difficulties finding targets the concentration of all the ships into a few small areas vastly added to these difficulties. Also, the problems of attacking convoys were increased by the defensive escorts patrolling the edge of

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[1]Capt. S. W. Roskill, "Capros not Convoy," USNIP, Vol. 87, no. 10, October, 1956, p. 1052.

Table V-2 The Distribution of British Shipping in Home Waters, Atlantic and Mediterranean on an Average Day before the Introduction of Convoys.

Donald Macintyre, U-Boat Killer, (London: Weidenfeld and Nicolson, 1956) between pages 60-61.

Table V-3 The Distribution of American and British Convoys and Ships Sailing Independently in Home Waters, Atlantic and Mediterranean in Mid-August 1943, when the Convoy System was in Full Operation.

Macintyre, U-Boat Killer, between p. 60-61.

the group. These escorts could, if they spotted the submarine, force it to submerge where they were no longer effective attack weapons and vulnerable to the escort's weapons.

The escort's prime attack weapon during the early part of the war was the depth charge, a container filled with several hundred pounds of explosives set to detonate at a predetermined depth. They were either fired off the side of the ship or dropped off the stern. Since some time elapsed before the charges sank to the predetermined depth at which they were supposed to explode, there was a chance that the submarine would maneuver away from the sinking charges and not be within the leathal radius when they exploded. Depending on a number of conditions, U-boats could be detected by asdic at an angle of 65° from the horizontal. Depending on the depth of the U-boat, speed of the attacking escort, rate at which the depth charge fell and other conditions the submarine could have traveled several hundred yards before the escort's explosives firec. In order to evade this problem the tactic was developed whereby two escorts worked in conjunction. Captain Walker, who may have been the most successful escort commander of the war, developed the use of two escorts to a fine point. One escort stood off from the submarine and retained contact, while another passed over the submarine. The escort maintaining contact with the submarine talked to the attacking one and informed it when the correct position to launch its charges was attained.[1] Since the U-boat commander had difficulties hearing the approaching attack escort he was many times unaware that an attack had been launched until he was blanketed by depth charge explosions. Also, if he maneuvered during the period when the attacking ship's asdic was inoperative the other destroyer immediately relayed

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[1]Robertson, Walker, R. N., p. 116.

the change in position and corrections were made before the charges were launched. In order to understand this operation better a diagram (V-4) has been reproduced on the next page.

Another role of the escorts in convoy action was the destruction of attacking aircraft. As already noted, at the first of the war destroyers were ill-equipped to deal with aerial attack because they had not received sufficient anti-aircraft armament. After studying the design of destroyers in the 1943 Brassey's and comparing them with the 1939 design it became readily apparent that the anti-aircraft armament had increased.[1] They were no longer equipped with armament which was only satisfactory for firing at surface targets but had been issued dual purpose guns.

Destroyers were from time to time used as anti-aircraft support for convoys, particularly in two areas, the Arctic runs to Russia and the Mediterranean runs to Malta. They escorted convoys to Russia from 1942 to late 1944 and convoys to Malta from the latter part of 1940 to the latter part of 1942. Table V-5 on the next page shows the general cruising formation of escorts and the change in formation when aerial attack threatened. Since destroyers were used for so many vital and different operations in the Mediterranean, including evacuation, escort and shore bombardment, it was necessary for them to have sufficient anti-aircraft armament for their own protection. During operations in the Mediterranean it was repeatedly shown that it was impossible for destroyers to survive in an area controlled by enemy aircraft without high angle guns.[2]

In the Atlantic and Mediterranean destroyers suffered their heaviest losses from aerial attack. Of the 126 British destroyers lost in the Atlantic theater

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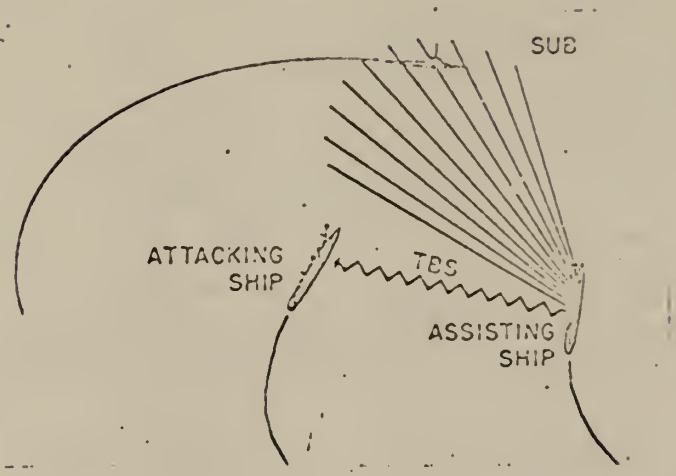
[1] Brassey's, 1943, p. 213.

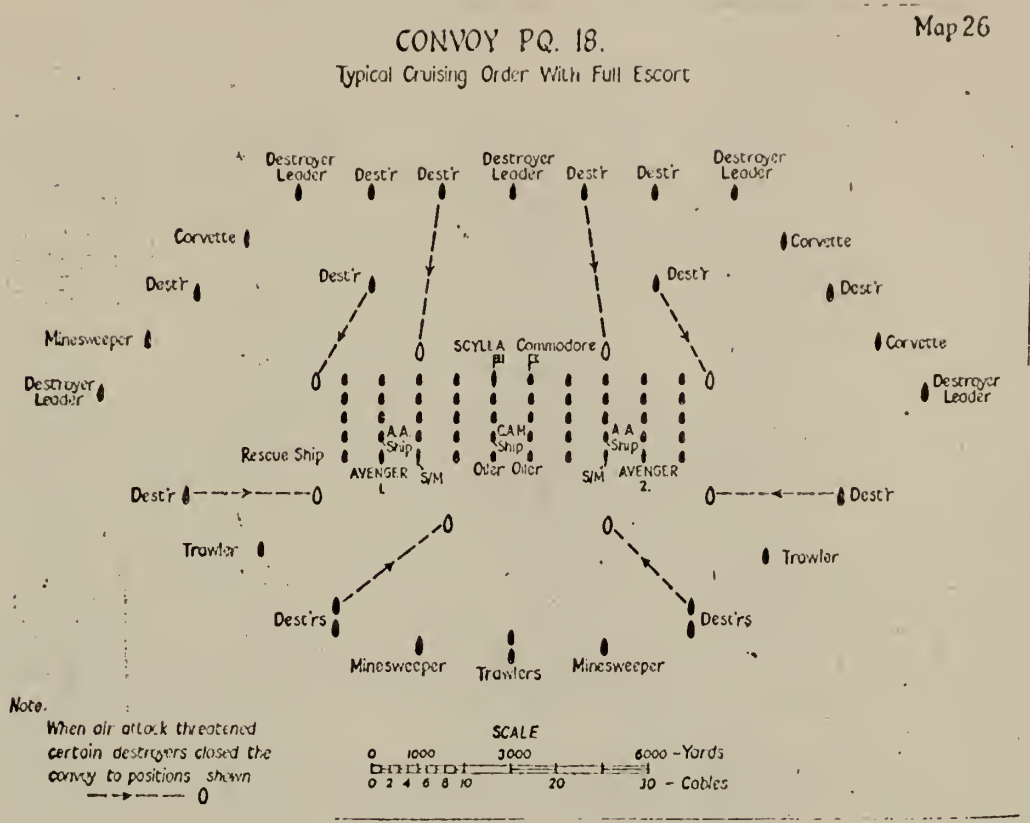
[2] Pugsley, Destroyer Man, p. 95.

Table V-4 Diagram of a Two Ship Co-ordinated Attack on a Submerged U-Boat.



Roscoe, U. S. Destroyers, back cover.

Table V-5 Diagram of Convoy PQ 18 Showing the Typical Cruising Order of the Escorts and the Change in Position when Air Attack Threatened.



Roskill, War at Sea, Vol. II, p. 282.

48 or 38.1% were lost because of air attacks.[1] Only four out of forty frigates and corvettes were lost because of aerial bombs and torpedoes. The reasons for the smaller losses for frigates and corvettes were because they came into the war later and for their size were better equipped with anti-aircraft armament. Also, the smaller ships seldom worked in the narrow seas where the threat from aircraft was more prevalent than in mid-Atlantic. They seldom operated near inshore waters or went on shipping sweeps in the Channel. The destroyers worked in the narrow seas of the Mediterranean, escorted ships in the shallow waters around England, and were used to attack enemy inshore shipping.

7. Destroyers in Offensive actions.

Throughout the war destroyers engaged in many serious and valuable surface actions with opponents far exceeding them in size. It was not the small and relatively ineffectual guns which the destroyers carried, but their torpedoes that made them dangerous to the larger surface ships.

Two cases in particular showed the ability of the modern destroyers to hold its own with far larger antagonists. The first of these actions was their participation in the sinking of Bismark. After the great German battleship had been slowed and severely damaged by aerial torpedoes the British destroyers Cossack and Maori attacked and two of their torpedoes struck home. These two hits, according to Korotkin, caused Bismark temporarily to come to a complete stop and the bow section was enveloped in flames.[2] Certainly Bismark was a doomed ship when the attacks were launched but the next morning when the British battleships arrived she still had enough fight in her to engage in a main armament gun duel.

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[1]Admiralty, Ships of the Royal Navy.

[2]Korotkin, Battle Damage, p. 178-80.

The 21-inch torpedoes which were launched by the destroyers were heavier than the 18-inch torpedoes launched by aircraft by more than 280 pounds of explosives. While the damage caused by the aerial torpedoes was responsible for the stopping of Bismark in her flight for hime, the effect of the destroyers in adding further damage should not be underrated.

A more clear case where a battleship would not have been sunk at all if it had not been for the actions of destroyers was the sinking of Scharnhorst in arctic waters in December, 1943. During a gun duel with the battleship Duke of York and the cruisers, Norfolk, Sheffield, Belfast, and Jamaica, Scharnhorst suffered several major caliber hits but other than making the forward turret inoperable and destroying the radar apparatus Scharnhorst's fighting capacity was not impared. Destroyers in this operation were used to slow Scharnhorst so the heavier ships could catch up.[1] This at first seemed strange because while Scharnhorst was faster than any of the heavy British ships the destroyers in a heavy sea would have had difficulties catching a 31 knot battle-cruiser. Apparently they were able to overtake the battle-cruiser because for a period of nearly an hour Duke of York ceased fire because of the opening range. Edgar March noted that at least one destroyer, Saumarez, got seven more revolutions that she had on her trials.[2] In all probability had the destroyers not been successful in their attack on the German battle-cruiser, she would have made it back safely to Norway.

Throughout the war both in the Atlantic and more particularly in the Mediterranean destroyers operated with the fleet. In the Mediterranean they shrouded British convoys with smoke to lower visability and conceal them from

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[1]Korotkin, Battle Damage, p. 188.

[2]March, British Destroyers, p. 406.

the attacks of heavier warships. The Italians, recognizing the danger from torpedo attacks, consistently refused to pass through the smoke screen.

In order for torpedo attacks to be successful they had to be launched in periods of low visibility. Either weather, smoke or nightfall gave the destroyers the protection necessary to approach to practically point-blank range. Such short ranges werenecessary to launch torpedoes accurately. One major caliber hit, and not more than a few, were enough to sink most destroyers. One instance where they did not have the advantages of bad visability was the action against the battle-cruisers Scharnhorst and Gneisenau. In April of 1940 the two battle-cruisers were steaming off Norway when they approached the carrier Glorious returning with a load of airplanes which were being evacuated. The destroyers Acasta and Ardent, escorting the carrier, attempted to attack the German warships. They were sunk in short order. Valiant as the attack was the visibility was too good. Scharnhorst and Gneisenau opened fire on Glorious at 27,000 yards.

Another offensive use of escorts was hunter-killer groups. The defensive method of employing escorts, convoys, had already been mentioned. Hunter-killer groups roamed the ocean finding submarines and were not tied down to the protection of a convoy. The American hunter-killer groups were formed around an escort carrier. The British groups were usually several sloops or corvettes. At any rate, they were brought into being by three developments: High Frequency Directional Finders (HF/DF or Huff-Duff), large numbers of escorts and air surveillance.

The radio directional finders gave the Admiralty the ability to discover the area where submarines had gathered. Since it was part of Admiral Doenitz's

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[1]March, British Destroyers, p. 257.

plan that the submarines maintain close contact with headquarters, the British monitored their radio broadcasts and determined their location. Once this information had been gathered the hunter-killer groups were directed to the general area.

Large numbers of escorts gave the Allies the ability to maintain these task forces. Before 1943 there were not enough escorts to sufficiently protect the merchant ships. During the period before 1943 the purpose of escorts was to protect the merchant ships. After the summer of 1943 there were enough ships to satisfactorily defend the convoys and it became possible for the extra ships to attempt to sink the submarines.

Air surveillance had two abilities in the hunter-killer operations. Airplanes either from shore or from the American carriers could attack the U-boats and shadow them until the destroyers arrived to finish the job. Aircraft were a vital part of the hunter-killer group.

The advantages of hunter-killer groups were that they found the submarines before they were in a position to attack the convoy. Also, they allowed the crews of the submarines no place to withdraw from the battle and relax for a few days until another convoy approached. Captain Rayner expressed the opinion of the supporters of convoys in noting that the protection of shipping was primary and the destruction of submarines was only secondary.[1]

Whether the protection of convoys could best be achieved by close escort or by groups hunting submarines long distances from convoys is still a matter of discussion. Close escort for the convoys gave the captains of merchant ships a sense of security or at least if they were sunk an immediate method of retribution

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[1]Rayner, Escort, p. 87.

was available. The problem was that the escorts for a convoy could not be spared long enough to insure the kill of an attacking submarine. Convoys had the advantage of concentrating the submarines in an area where they would not have to be hunted down. It seems that the solution, which was a compromise, was to have two escort groups for the convoy. One would stay with the convoy throughout the voyage and the other would engage submarines until they were destroyed even though the convoy passed on. During the early stages of the war there were not enough escort vessels to provide two seperate groups.

After 1943, when escorts were plentiful enough, the use of hunter-killer groups brought results. Still convoys had to be protected but there were considerably fewer offensive captains of the nature of Gunther Prien. The hunter-killer groups removed the submarines before they could attack the convoys and made the escort's job that much easier.

Destroyers performed other offensive actions, although they were somewhat less important than torpedo attacks on surface ships and hunter-killer groups. They were used in special commando operations such as the raid against the Normandie Dock at St. Nazaire. During this raid the destroyer Campbeltown was filled with explosives and rammed into the only dry dock in occupied Europe large enough to hold the Tirpitz. While ramming into the dock a number of troops were landed and destroyed pumping facilities and other important parts of this dry dock. Heavy casualties were suffered by the attending craft and troops but after the delayed mechanism fired the explosives in the Campbeltown the dry dock was damaged beyond repair.[1]

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[1]For the complete story of the operation see C. E. Lucas Phillips, The Greatest Raid of All, (London: Heinemann, 1958).

The destroyer during the Second World War also was used for close shore bombardment and evacuation. While the battleships fired at troop concentrations far inland the destroyers shelled enemy implacements on shore. It must be remembered while the average five inch gun of a destroyer was a small naval piece they would have been very large guns for the land forces. During the various evacuations that were performed by the British services during the war destroyers bore the lion's share of the work. They not only fought off attacks at the receeding beach heads but also transported troops out of danger.

8. Escort operations during World War II.

During operations in the Atlantic and Mediterranean escorts sank 246 German submarines out of the total 781 that were lost. A further 46 German submarines were lost due to the efforts of destroyers and aircraft. All told escorts accounted for 292 German submarines and most of these were lost during or shortly after attacks on convoys.[1] The added advantage over sinkings at sea by escorts and attacks on submarines in harbor was that the trained crews, which in many cases were more difficult to replace than the submarine, were either killed or captured. Further when the escorts were protecting a convoy and sank a German submarine the losses were double because not only a submarine was lost but the chance for a successful attack was lost also. During the war 31.5% of all German submarines sunk were lost to escorts. When the losses because of combined attack were added to those solely because of escorts the percentage rose to 37.4%. The larger portion of the German submarines lost because of destroyers came during the early part of the war. Later in the war when the air attacks began to take effect, both the actual numbers and the percentages of German submarines lost because of escort attacks declined.

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[1]Admiralty, German Italian and Japanese U-Boat Casualties.

Italian submarine losses because of attack by destroyers numbered 37 and when assisted by aircraft a further five sumbarines were lost during the war.[1] The Italian submarines losses because of attack by surface ships amounted to 43.5% of the Italian losses. When escorts and aircraft were added the figure rose to 49.4%. The higher percentages of Italian submarines lost because of escorts were explained by noting that Italy surrendered in September, 1943, before the Allied airpower began to exert its overpowering influence on the submarine war.

The British losses of submarines because of attacks by Axis vessels were lower than either German or Italian losses. During the war in both the Atlantic and Mediterranean 72 British submarines were lost by enemy action. Only 15, or 20.5% of the losses were caused by surface vessels in any manner.[2] Strangely the majority of these losses were in 1942 and 1943. The ten submarines sunk by surface action during 1942 and 1943 were lost in the shallow waters of the Mediterranean. There were certain advantages for submarines working the Mediterranean but it was also dangerous. In the Mediterranean the water was clear enough to see a submarine from an aircraft at about 120 feet, compared with 30 feet in the North Atlantic. Also, the bottom of the sea was white and the submarine contrasted easily in the Mediterranean.

Table V-6 on the opposite page shows the losses of British, German and Italian destroyers and escorts. From this table it was possible to derive some meaningful statements about the ability of destroyers and escorts. The only

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[1]Admiralty, German, Italian and Japanese U-Boat Casualties.

[2]Admiralty, Ships of the Royal Navy.

Table V-6 British, Italian, and German Destroyer Losses During the Second World War in the Atlantic Theater.[1]

	Destroyers		Escorts	
Losses Due To	Number	Percent	Number	Percent
Aircraft				
British	48	38.0%	56	31.8%
German	9	20.0%		
Italian	17	28.8%		
Submarines				
British	33	26.6%	67	38.0%
German	0	0.0%		
Italian	6	10.1%		
Surface Actions				
British	9	7.2%	9	5.1%
German	20	44.4%		
Italian	12	20.3%		
Mines				
British	9	7.2%	13	7.4%
German	6	13.3%		
Italian	6	10.1%		
E-Boats				
British	8	6.4%	8	4.5%
German	1	2.2%		
Italian	0	0.0%		
Shore Batteries				
British	2	1.6%	4	2.1%
German	0	0.0%		
Italian	1	1.6%		
Accidents				
British	9	7.2%	13	7.4%
German	6	13.3%		
Italian	13	22.3%		

[1]Derived from Admiralty, Ships of the Royal Navy, S. W. Roskill, War at Sea, Vol. III, pt. 2, p. 457-461., "Official Recapitulation of Italian Losses: Navy Department Press Release,: USNIP, July, 1946, p. 1006-9. The losses for German and Italian corvettes, frigates, sloops, cutters, and other related vessels are not available. Also it will be noticed in this table that from time to time the percentages add up to make more than a hundred percent. This phenomenon arises because if a vessel has been lost because of more than one cause both causes are included in the tally.

really worthwhile statements can be made about destroyers because the figures for German and Italian losses of escort craft only listed destroyers. Because of aircraft, losses of British destroyers were considerably higher than the Italian and German losses. This seems to indicate that the British needed additional anti-aircraft weapons on their destroyers during the early part of the war. By the time that aircraft had become a powerful British naval weapon Germany and Italy had witnessed the necessity of possessing guns capable of bringing down aircraft. The German figures showed no losses because of submarines which indicated that the British did not place so much emphasis on this type weapon. The second highest source of British destroyer losses was submarines. The tremendous jump of nearly half of the destroyers lost because of surface action by the Germans shows the importance of strength of the British surface fleet. Mines sunk about an even proportion of each of the fleet's destroyers.

Through this section on destroyers and other escort vessels their prime antagonist has been the submarine. At this occupation they were unexcelled by any other seagoing weapon. This was their main job and until aircraft came into prominence in 1943 they were nearly the sole weapon of anti-submarine warfare. Even after the arrival of aircraft, escorts were still extremely useful in anti-submarine warfare. Destroyers, perhaps because they were a cheap and expendable commodity, were used for a number of other tasks. Shore bombardment, anti-aircraft work, attacks on capital ships, evacuation, and commando raids were only a few of the many jobs which the destroyers performed during the Second World War. When the final analysis was done it was found that perhaps destroyers were not the most effective of naval weapons but it was one of the most versatile.

9. Armed Merchant Cruisers.

Armed merchant cruisers were an odd breed of ship left over from the days of privateers. They looked like merchant ships but were armed with various assorted guns. The idea behind these ships was they could fool other vessels into believing that they were merchant ships and manage to approach them unsuspected.

The British used theirs in a defensive manner protecting other merchant ships. They operated in the ocean and hoped that they could fool submarines into attacking them. The British merchant cruisers hoped that a submarine would surface near them and they could then sink the U-boat with their hidden guns. The Second World War in the Atlantic showed that they were remarkably effective at finding submarines. During the war 70.1% of the British armed merchant cruisers were sunk by Axis submarines. Another 21.4% were sunk by surface raiders and one was lost because of an accident.[1] While they were effective at finding submarines they were not effective at destroying them; the Admiralty listing of Axis submarines lost showed none were sunk by armed merchant cruisers.[2]

The German armed merchant cruisers were used, in the 1939-45 War, in a completely different manner. They were used offensively as surface commerce raiders. Several of these ships armed with five inch guns and perhaps a torpedo tube were sent out on commerce raiding missions during the war. In the Atlantic they sank 213,617 gross tons of British merchant shipping and several thousand tons in the Indian and Pacific Oceans, mostly in the far reaches of the ocean away from both shore and commerce lanes.[3] Their method was to approach an unsuspecting merchant

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[1]Admiralty, Ships of the Royal Navy.

[2]Admiralty, German, Italian, and Japanese U-Boat Casualties.

[3]Admiralty, British Merchant and Fishing Vessels.

ship and either have it surrender or sink it before a radio message could be sent out. Since they did not have enough fire power to compete with modern warships a radio message would virtually insure their destruction if a warship was in the area.[1] Also, the German merchant raiders could not attack convoys, even though shipping was heaviest there because of the danger of the escorts and once again a radio message was certain to bring retaliation.

10. Motor boats.

The motor torpedo boats, or E-boats as the Germans called them were small fast craft usually made out of wood and carrying one or two torpedoes and a few machine guns. These small wooden craft did not operate in oceanic waters but along the east and south coast of Britain and in the Mediterranean. They attacked small coastal shipping and convoys which were gathering near ports in these areas. One of the German tactics was to lie in shallow waters close to the English shore; the boat would remain unseen because of the darkness of the land to their back until a target passed near them. Then with a sudden burst of speed the E-boats would rush out and attack the merchant ships launching torpedoes on their way.[2] High speed and maneuverability made these craft very difficult to hit even under the best of conditions. Given a hazy night or bad weather they could be reasonably certain of escaping destruction. The British in an effort to develop a weapon that would be effective against the German E-boats built the motor-gunboat. Usually known by its initials MGB, it carried no torpedoes but was similar to the torpedo boats. MGB's carried only guns to attack E-boats.

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[1]The Australian cruiser Sydney was sunk by the German commerce raider Komet in the Indian Ocean but not before the raider itself was sunk.

[2]William G. Scholfield, Eastward the Convoys, (Chicago: Rand McNally and Comp., 1965), p. 88-9.

Darkness was the best hunting time for small torpedo boats. Peter Scott, a former commander, listed four reasons for the small craft hunting at night: (1) the enemy convoys which were harassed by aircraft during the day sailed at night, (2) surprise was essential against escorted convoys, (3) during daylight the fire-power of the escorts was too powerful for the close approach necessary for successful torpedo actions, and (4) aircraft and shore batteries could be used against the MTB's during the day.[1]

Table V-7 on the opposite page shows the losses of British and German motor boats in both Atlantic and Mediterranean Theaters. This table showes that it was not enemy action that destroyed the largest number of British motor boats but that accidents of one sort or another caused 49% of the British losses. The German losses on the other hand, including those scuttled, were considerably smaller than the British accident losses. Mines and other surface ships were about equal in the number of E-boats they sank. The Germans suffered their heaviest losses from air attack, but of the 27 boats sunk by this method 23 were in harbor when they were lost.

During the Second World War the British lost 154,922 gross tons of shipping in both Atlantic and Mediterranean waters because of E-boat attacks. Nearly all of the ships lost because of E-boat attacks were sunk in the shallow waters around England, particularly the North Sea and English Channel.[2]

E-boats were mostly nuisance and psychological weapons. They caused the diversion of forces needed elsewhere and never allowed the pressure to be taken off convoy escorts. During the period in the middle of the war when submarines

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[1]Lt. Cmdr. Peter Scott, The Battle of the Narrow Sea, (London: Country Life Ltd., 1945), p. 11.

[2]Admiralty, British Merchant and Fishing Vessels.

were attacking in mid-ocean E-boats made it necessary to continue to convoy ships when they were merely passing from port to port along the east coast of England. During the invasion of Europe they were a threat because of the heavy concentration of shipping in the narrow waters of the invasion area. Even though they were a threat, the losses suffered by the landing forces were minimal.

11. Other weapons used in naval warfare.

Numerous other weapons need to be mentioned but did not cause enough damage or confusion to deserve a seperate section by themselves. Among these weapons were: one-man torpedoes, minature submarines, frogmen, explosive motor boats, sabotage, shore batteries, and defensive armaments on merchant ships. Most of these weapons were one time affairs; they could dramatically influence the nature of the war once or twice but their long range value was nearly non-existent. The only reason they have been mentioned at all is so readers of this paper would recognize that they did exist but it must be warned that their effectiveness during the war was seriously limited.

Table V-7 Losses of British and German Motor Boats in Atlantic and Mediterranean Theaters.[1]

	MTB		MGB	
	Number	Percentage	Number	Percentage
Mines				
British	18	16.7%	7	25.0%
German	8	14.2%		
Aircraft				
British	13	12.0%	3	10.7%
German	27	45.3%		
Surface Action				
British	19	17.6%	5	17.8%
German	8	14.2%		
E-Boats				
British	5	4.6%	1	3.5%
German	4	7.1%		
Shore Batteries				
British	1	0.9%	1	3.5%
German	2	3.6%		
Accident				
British	53	49.0%	8	28.5%
German	5	8.9%		

[1]Derived from Admiralty, Ships of the Royal Navy, and Roskill, War at Sea, Vol. III, pt. 2, p. 458-461. The losses of German torpedo boats in Roskill are not broken down into MTB and MGB.

CHAPTER VI

SUBMARINES

1. Submarines before World War II and the nature of undersea warfare.

In 1902, when submarines were first becoming operational weapons of war, Admiral Sir Arthur Wilson, who became First Sea Lord in 1910, described the new weapons as "underhanded, unfair, and damned un-English."[1] Wilson did not recognize how un-English these weapons were to become later in the hands of England's enemies. During the period of unlimited submarine warfare in the 1914 War the U-boat nearly brought victory to the Germans. During the second war with Germany the submarine was in terms of tons of ships sunk far more dangerous than in World War I. Not only were submarines more destructive than any other Axis naval weapon but they sank more Allied shipping than all other weapons in the German and Italian naval arsenals combined.

After the defeat of the German submarines, along with the rest of the Kaiser's forces, the Admiralty seemed to sink into complaisancy. The Treaty of Versailles forbade Germany from ever again building submarines. Like so many other portions of the treaty this section was evaded by Germany. During the period when Germany could not build submarines or have a force of them, German owned and operated building yards in foreign countries built submarines for various other nations. By this evasive means Hitler's regime had a trained construction and design staff available. After the Anglo-German Naval Treaty of 1935 Germany was allowed to build submarines, under certain conditions, up to 100% parity with the British. Thus after this treaty there was a sudden building of a submarine force with little or no time lost for design.

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[1]Kuenne, Attack Submarine, p. 125.

During the period when Germany had no submarine force of its own, a number of officers spent their time in surface vessels. Admiral Doenitz who until 1943 commanded the U-boat arm, and later was Commander-in-Chief of the German Navy, served his time in the light cruiser Emden.[1] There was no evidence to show how valuable this experience in surface ships was to the leaders of the German submarine program, but certainly they understood the problems of surface ships and could better devise means of attacking them. Also a number of submarine commanders, such as Gunther Prien, who took his U-boat into the British base of Scapa Flow and sank the battleship Royal Oak, were sailors who had gotten their original training in the merchant marine. This was put to good use during the war against British commerce in the Atlantic.

Britain during the period between the wars spent little time worrying about the best possible method of countering submarines. Placing their faith in asdic they believed that the German U-boats were no longer a threat to their maritime security. Far too much confidence was placed in this new means of detection.[2] Numerous difficulties were experienced with asdic during the war. Among them was its inability to detect submarines in shallow water, on the surface and outside the range of torpedoes. All this will be discussed in a later section of this chapter but it has been brought up here to illustrate the lack of comprehensive thinking shown by the Allies during the inter-war years.

One of the most potent weapons used in anti-submarine warfare was all but ignored in American naval journals, and probably British ones too. There was only one article in the United States Naval Institute Proceedings which studied the

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[1]Grand Admiral Erich Raeder, My Life, Trans. Henry W. Drexel, (Annapolis, Maryland: United States Naval Institute, 1960), p. 172.

[2]Kuehne, Attack Submarine, p. 5.

effect of aerial attack on submarines during the First World War.[1] Admittedly there was little information which would have been useful for historical analysis. Perhaps the lack of historical information was a valid reason for little study of the aerial attack on submarines during World War I but it still does not excuse the failure to derive their effectiveness in training exercises. Air Chief Marshal Sir Philip Joubert, who during part of the war commanded Coastal Command, criticized the leadership of the British Naval Staff for failing to pay attention to attacking submarines from the air during the combined defense exercise in 1937.[2] This lack of study on methods of destroying submarines from the air was one of the failures of British naval planning. Had sufficient attention been paid to this problem the success of airplanes might have been realized at the start of the war instead of in 1943.

The submarine was commonly viewed as a weapon which stealthly approached its victum underwater and launched a torpedo. This common misconception about the ability of World War II submarines to stalk their enemy without surfacing was disproved by Atlantic operations during Hitler's war. U-boats had a very low underwater speed and could not easily attain attack positions while submerged. They were not true submersibles, like the nuclear submarines of today, but surface craft which could, for short periods of time, proceed underwater.[3] Usually submarines submerged only to escape detection and to evade attackers. Their underwater speed was seldom more than seven or eight knots and this was only for limited periods of time. The ability of the submarine to stay underwater decreased

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[1]Robert M. Grant, "Aircraft Against U-Boats," USNIP, Vol. 65, no. 6, June, 1939, p. 824-828.

[2]Joubert, Birds and Fishes, p. 109.

[3]Kuenne, Attack Submarine, p. 11.

out of proportion to the speed it used while submerged. At very slow speeds, perhaps not more than a knot or two a submarine could have stayed down for more than 24 hours, but at higher rates of speed the submarine's underwater endurance decreased rapidly.

The underwater endurance of a submarine was determined by two factors, batteries and oxygen. Unless the submarine could rest on the bottom, its motors had to be constantly turning so that it would neither rise to the surface nor sink below a depth where its pressure hull would have collapsed. A submarine could not stop dead in the water and remain at the same depth. Therefore throughout its journey underwater it was necessary for the submerged vessel to run its engines and consequently deplete its batteries. On the other hand, the factor which caused submarines to surface after staying down for long periods of time was not the need for recharging the batteries but the need to replenish the air. The method of extracting oxygen from the water had not been invented in World War II. Although a number of methods of expanding the air supply--such as air purifiers and compressed oxygen--were tried, none allowed the submarine to remain underwater indefinitely.

Also while proceeding underwater submarines lost a great deal of their offensive capabilities. The periscope, which is so commonly used for attacks in war movies, had a very small range of vision and could not search wide reaches of the oceans. Because of the relative ineffectiveness of the periscope it was difficult for submarines to develop an effective attack on a moving target. In order to gain the data necessary to launch a torpedo accurately, submarines had to make a number of observations on the ship which was being approached. Using the periscope there was no chance to keep an eye out for the escorts which were usually patrolling the area. The periscope also was only effective during daylight

and when the sea was calm. During other periods the submarine's periscope was either sticking so high out of the water that it became easily noticed, or during darkness not enough light was available to make targets show up distinctly through the periscope. These problems were alleviated somewhat. During exceptionally rough seas the periscope and its accompaning "feather"--the water thrown up by the scope--were hidden by the waves. Also, during exceptionally bright nights enough light was present to make the periscope effective.

W. J. Holmes in his work on American submarines in the Pacific described the problems of attack by submarines. He noted that while the submarine was underwater it could have gained attack position but a sudden burst of speed depleted its batteries. This depletion caused by increased speed to arrange a correct attack position allowed the submarine a small reserve in case it was counter-attacked by an escort. Also, if the target zig-zagged or changed its pattern of movement the chance of a successful attack was lost.[1] Diagrams on the next page (Charts VI-1 and VI-2) show the standard method of attack by submarines on surface ships. It will be readily noticed that torpedoes suffered from a disadvantage not common to artillery shells. During an attack by gunfire the projectiles flew towards their target at several hundred miles an hour. Torpedoes on the other hand moved only a few knots faster than the targets they were supposed to sink, perhaps 35 to 40 knots. This caused certain difficulties in accurate aiming because the lead time was so much greater for torpedoes than it was for shells. Also, torpedoes left a track of their progress through the water which allowed the captain of a vessel to maneuver his ship in a manner so that

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[1]W. J. Holmes, Undersea Victory: The Influence of Submarine Operations in the War in the Pacific, (Garden City, New York: Doubleday and Company, Inc., 1966), p. 12.

Table VI-1 The Approach Phase by an Attacking Submarine.

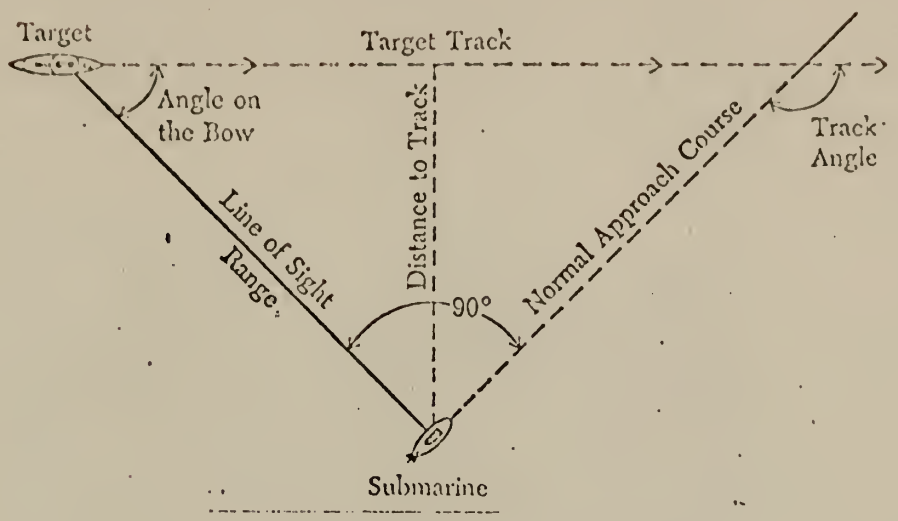
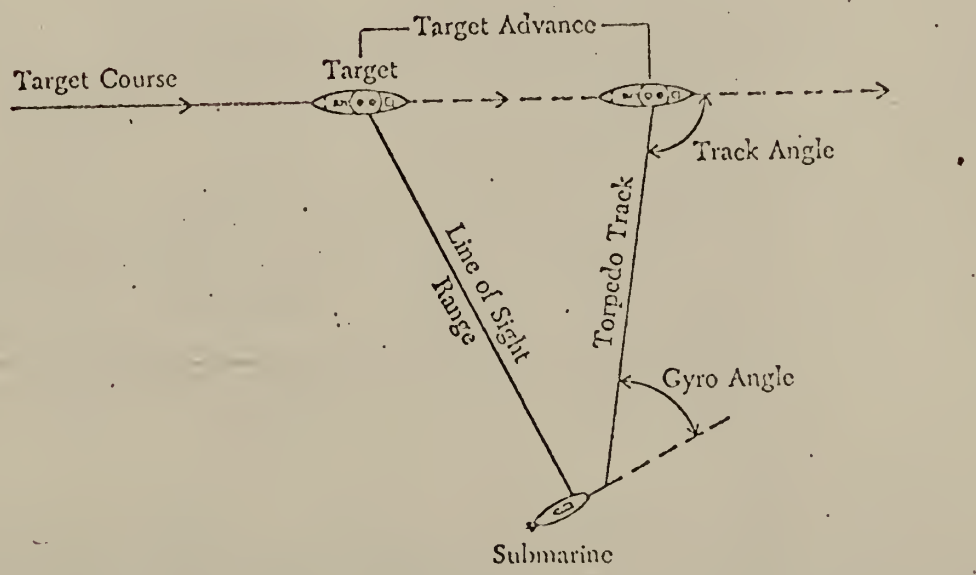


Table VI-2 The Attack Phase of an Attacking Submarine.



Homos, Undersea Victory, p. 12 and 14.

it would not be struck; the development of electric powered torpedoes, which left no wake alleviated this problem. Ships that were engaged by gunfire maneuvered swiftly to throw off the enemy's aim, but not to maneuver out of the path of the projectiles. Rapid maneuvering under torpedo attack caused the torpedo to miss even though it had been aimed correctly.

Submarines had many attributes which made them ideal for commerce raiding. One of these was their extremely long range. It was nothing for submarines to sail 12,000 to 15,000 miles on war patrol during the Second World War. This gave them the ability to strike at unprotected areas far from their homeland, such as the coasts of North America, South America, and South Africa. Later in the war, in order to increase the capacity of submarines to stay on patrol, a number of supply U-boats or "milch cows" were built. These large submersibles carried food, fuel, torpedoes and other stores to U-boats on station so that they would not have to return to their base of operations.

Geographical factors affected the amount of time spent on war patrol. During the sudden military campaigns of 1940 Germany gained many advantages. The coast of Norway and the French coast were occupied by the German armies in 1940. This made it a great deal easier for the German U-boats to escape into the Atlantic. They no longer had to make the dangerous passage through the minefields in the Straits of Dover nor the long trip around the Northern tip of England. By cutting down the traveling time to the zone of operations submarines stayed on station longer. The geographical advantages of the conquests made by the German Army to the U-boat war can be shown by studying two reports made to Hitler in 1939 and 1942. In a survey of planned submarine construction made in 1939 the number of U-boats which it predicted would be available was roughly one-third of the total

submarine force.[1] As noted this report was made before any advantages had been gained by the conquest of France and Norway. In a report made in 1942, 32 out of 106 submarines available were in ports in France and Germany undergoing repair. A further 12 submarines were in Italian ports replenishing. Only four out of seventeen not in port were en route to their zone of operations. Compare this figure with the 26 out of 35 submarines that were either en route or returning from operations off the American coast during February, 1942.[2] The success of the submarine war was partially dependent on the number of submarines that could be kept on station during any given period. If enough submarines were attacking British commerce the defenses were flooded and the successes were out of proportion to the increased number of U-boats. But conversely if the number of attacking craft fell below a certain level, the losses of shipping fell out of proportion to the decrease of submarines.

The U-boat's ability to stay on patrol was limited by the distance to the area of operations. Many times as much as one-third or one-half of the U-boat's operational time was lost during transit to its patrol area. Taking into consideration the amount of time necessary to refresh the crews and repair the submarines in port one-third of their effective lives were lost. Three hundred submarines were required to keep one hundred on patrol in their operational area.

2. Submarines in defensive operations.

The submarine during the Second World War was basically an offensive weapon. It had neither heavy guns to do battle with its opponents nor armor protection

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[1] Fuehrer Conferences, 1939, Report of the Commander in Chief, Navy to the Fuehrer, 22 November, 1939, p. 42.

[2] Ibid., Report to the Fuehrer made by the Commander in Chief, Navy 13 February, 1942, p. 13.

necessary to withstand the superior gunfire of the attacking escorts. Its main defensive tactic was to hide after being sighted and even better never to be seen. Kuenne noted that while the typical vessel gained advantages against its own kind by increases in size, firepower, or defensive armament submarines were not designed to fight their own kind.[1] The submarine gained very little from an increase in any of these factors. Brodie in the 1943 edition of Sea Power felt that the larger the submarine was the more vulnerable it was to attack by escorts. He noted that the primary determinate of the submarine's ability to withstand punishment was how much its pressure hull could withstand. Noting that the larger submarine had more hull area without any increase in ability to take punishment he concluded that larger submarines were more vulnerable.[2] If, for instance, a submarine had been built which could have effectively competed with surface warships in a gunnery duel its offensive capabilities would have been severely limited. Because submarines were the only vessels which could sink below the surface to evade superior power, numerous sophisticated types of gear were developed during the war so that they could in a sense be "seen." Most of these inventions dealt with sending sound through the water. Either hydrophones, which were very sensitive listening devices, or asdic used sound to pinpoint the submarines. The hydrophones "listened" to the noises coming from the submerged submarines and the asdic sent out sonic vibrations which bounced off the U-boat and told its position. Both of these methods were only effective when used by surface ships. Escorts were the only weapons with the ability to remain on the spot long enough to force submarines to surface after having bombarded them with depth charges. Aircraft could by making sudden attacks on submarines that were just submerging force them to the top of the water but seldom saw a

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[1]Kuenne, Attack Submarine, p. 35.

[2]Brodie, Sea Power in the Machine Age, p. 353.

completely submerged submarine. Also, aircraft could spot submarines only when they were on the surface, either by eye-sight or radar. The escort was the only weapon which carried the gear necessary to detect a submarine underwater.

The British learned during the war that the German U-boat was a great deal more difficult to destroy than had previously been thought.[1] Several times mention was made in different works about the difficulties encountered early in the war with weapons which were given to the anti-submarine force. One of the first difficulties was that it had been thought that modern submarines could not go much below 500 feet. The German U-boats in emergencies went considerably below 500 feet, in fact sometimes as much as 800 feet. This caused the British depth charges to have too shallow a depth setting. Also, the lethal radius of the depth charge needed to be improved in order for the British escorts to have a better chance of collapsing the submarine's pressure hull. With the development of new explosives and heavier charges these problems were eliminated. Because the depth charge when it exploded ruined the ability of the attacking surface ships to use their listening gear a number of weapons, such as the "hedgehog" and "mouse trap," which were smaller than the depth charge but exploded only on contact, were developed. Aircraft had difficulties with the depth charge also. Usually aerial depth charges were pre-set to explode around sixty feet, roughly periscope depth of a submarine. It was not until late in the war that it was realized when airplanes attacked, submarines were usually just beginning to submerge and not yet at their periscope depth. The hunting of a U-boat during the war was a lengthy affair, requiring three to four escort vessels to insure success.[2]

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[1]Robertson, Walker, R. N., p. 38-9.

[2]Kemp, Victory at Sea, p. 275-6.

Table VI-3 German Submarine Losses by Cause.[1]

Cause of loss	Number	Percentage
Surface Ships	246	31.6%
Aircraft[2] in attacks at sea	290½	37.2%
Aircraft in bombing raids	63	8.0%
Ships and Aircraft combined	46	5.9%
Submarines	21	2.6%
Mines[2]	32½	4.1%
Other and Unknown[3]	82	14.9%

[1]Admiralty, German, Italian, and Japanese U-Boat Casualties.

[2]One submarine was shared by mines and air attacks at sea.

[3]Includes marine and training losses.

3. Submarines in offensive actions.

U-boats, offensive weapons, proved beyond all doubt their offensive capabilities in attacks on Allied ships in the Atlantic. The Admiralty history of the Battle of the Atlantic described the U-boat war as "one of the most vital, protracted and bitterly fought sea and air campaigns in which the British Empire and her Allies have ever been engaged."[1] John Herington in the Official History of the Royal Australian Air Force noted although the winning of the battle against U-boats would not in itself have won the war; the war most surely would have been lost by the Allies if they had not succeeded in defeating the German submarine threat.[2] For the most part the submarine war was fought in and around the convoys traveling to and from England. Although a number of serious threats arose in other parts of the ocean than the North Atlantic the threats were seldom as serious and protracted as those on the route between the United States and England.

Throughout the war one of the German U-boat's major preoccupations was finding the convoys. The early German submarines, not equipped with radar had very low freeboards. Sitting so low in the ocean, enemy vessels had to approach very close to a U-boat before it was seen. Later in the war when aircraft and escorts were patrolling the seas in large number, U-boats were forced to submerge. Once the U-boat was underwater it was very possible that a convoy would pass by unnoticed. The convoys, large as they were, could easily pass between

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[1]Great Britain Central Office of Information, Prepared for the Admiralty and the Air Ministry, The Battle of the Atlantic: The Official Account of the Fight against U-boats, 1939-1945, (London: HMSO, 1946), p. 5.

[2]John Herington, The Air War Against Germany and Italy, 1939-1943, (Canberra: Australian War Memorial, 1962), Series 3, Vol. III, p. 148.

two patrolling submarines in the vast reaches of the North Atlantic. Numerous methods and tactics were tried during the war so that it would be easier for convoys to be found.

In 1939 Admiral Doenitz, one of the few leaders who seemed to have a definite idea about how the war was going to be fought, argued for the concentration of submarines off the sailing ports of convoys, south-west England, Gibraltar and other locations where ships were easy to find.[1] By this means he hoped to gain contact with the convoys before they were lost in the vast reaches of the Atlantic. In this manner his U-boats did not have to spend much of their limited time on patrol trying to find the ships, but followed them as they left the ports. Because of inshore patrols, aircraft and other weapons which controlled the shallow waters it became increasingly difficult to make successful attacks on merchant vessels in and around the points of arrival and departure. Later in the war submarines derived certain advantages from operating in shallow waters, but discussion of this will be left to a later part of this chapter.

Before the war Admiral Doenitz, in order to alleviate the problem of the small reconnaissance ability of the submarine, developed theories and tactics which later became known as the "wolf pack." Doenitz was impressed with the inability of the submarine to search for and find targets. Consequently the German Admiral argued for the construction of many smaller submarines.[2] Several small submarines could more effectively cover an area than one large submarine. Also, during the war Doenitz was constantly arguing for trained aircrews and aircraft with sufficient range to spot convoys. He was seldom able to get effective air reconnaissance because many of the German aircrews were not trained to

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[1]Doenitz, Ten Years and Twenty Days, p. 61.

[2]Kuenne, Attack Submarine, p. 26.

navigate accurately over the vast reaches of the oceans. Because of the submarines' inability to see ships, a small error in navigation by the pilots meant that the convoy was never spotted by submarines. Apparently radio direction finding during the war was not accurate enough to pinpoint the convoys from the airplane's radio communications with Germany.

By knowing the weather conditions and by intelligence information gathered by various means the German Naval Staff predicted the path of convoys. Accordingly submarines were arranged in a line across the projected path of approaching convoys in hopes that it would not pass unnoticed. It was necessary for large numbers of submarines to be available to the German Navy. A guide for navy officers stated the visability of objects at sea from a 40 foot height was 7.1 nautical miles.[1] It seems that this figure can be used to measure the distance a submarine could see a ship. The masts of a ship were somewhat higher than forty feet but against the sky they did not show up well. Also, some height was gained from the conning tower of the submarine, but other factors entered the discussion. In the area bounded by 20-40° West and 40-60° North there was less than 50% chance of the visibility being greater than 10 nautical miles.[2] Therefore while it may not have been accurate that submarines could spot merchant vessels at seven nautical miles it at least presents a reasonable figure to give a basis of judging the difficulties of finding ships. One submarine would have to be placed every fourteen miles to insure that a convoy did not pass unnoticed. Therefore seven submarines were needed every hundred miles. Since convoys could

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[1]Bureau of Naval Personnel, A Navigation Compendium, (NAVPERS, 10494, 1966), p. 108.

[2]Chief of Naval Operations, U. S. Navy: Marine Climatic Atlas of the World. Vol. I, North Atlantic Ocean, (Washington, D. C.: U. S. Government Printing Office, 1955).

take any number of different paths to their destination large areas needed to be covered. Also, in order for the German submarines to be effective in their wolf-pack tactics constant radio communications with Admiral Doenitz was necessary. The Allies using Huff-Duff found where the submarines were patrolling and avoided areas of concentration.

Once a submarine made contact with the convoy it reported to command headquarters in France the location, direction and speed of the ships it had spotted. The submarine command then ordered the U-boat to continue to report its position as it shadowed the convoy. While this submarine was following the convoy other submarines were ordered to gather around it until there were enough vessels to make an effective attack. After enough U-boats had reached the area surrounding the convoy a concerted and simultaneous attack was launched. This attack, usually began at night on the surface, was aimed at splitting up the escorts. While some of the escorts were counter-attacking the submarines, other German boats were torpedoing unprotected merchant ships.

Robert M. Grant, who was one of the few authors which has comprehensively studied submarine tactics during the First World War, held that the wolf-pack idea was not original with Admiral Doenitz. Admiral Bauer, who commanded the German U-boats in World War I, suggested a plan similar to the wolf-packs, but they were never fully accepted by the high command.[1] There seems to be sufficient evidence that Doenitz was one of the few leaders who had correctly predicted the method of operation his weapons would use. Doenitz had a tactical plan at the first of the war to combat what he suspected would be the British countermeasures to submarine attacks. The wolf-pack was specificly designed to lessen the

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[1]Grant, U-Boats Destroyed, p. 43.

Table VI-3 on the next page shows the number and percentage of the German U-boats lost by cause. It can be seen that the various advantages of aircraft and surface vessels nearly equaled themselves out. Destroyers and other escort vessels sank a larger portion of U-boats in the early part of the war while aircraft were more effective after the summer of 1943. The escort's advantage in attacking submarines was that it could carry more depth charges and remain on the spot if necessary until the U-boat was forced to surface. There was slow realization of the need to hold the submarine down for at least 24 hours and get positive evidence of a kill. Aircraft's advantages were the suddenness of attack, which was launched while submarines were on the surface, and its superior reconnaissance ability. Combined together the two methods only sank a further 46 submarines. The lowest figures for German U-boats lost were those sunk by Allied submarines. The submarine was not basically a weapon which was designed to fight its own kind like the battleship. Mines sank a small portion of the German submarines but not a large enough number to worry the German Naval Staff. Their effectiveness was in denying certain areas to U-boats.

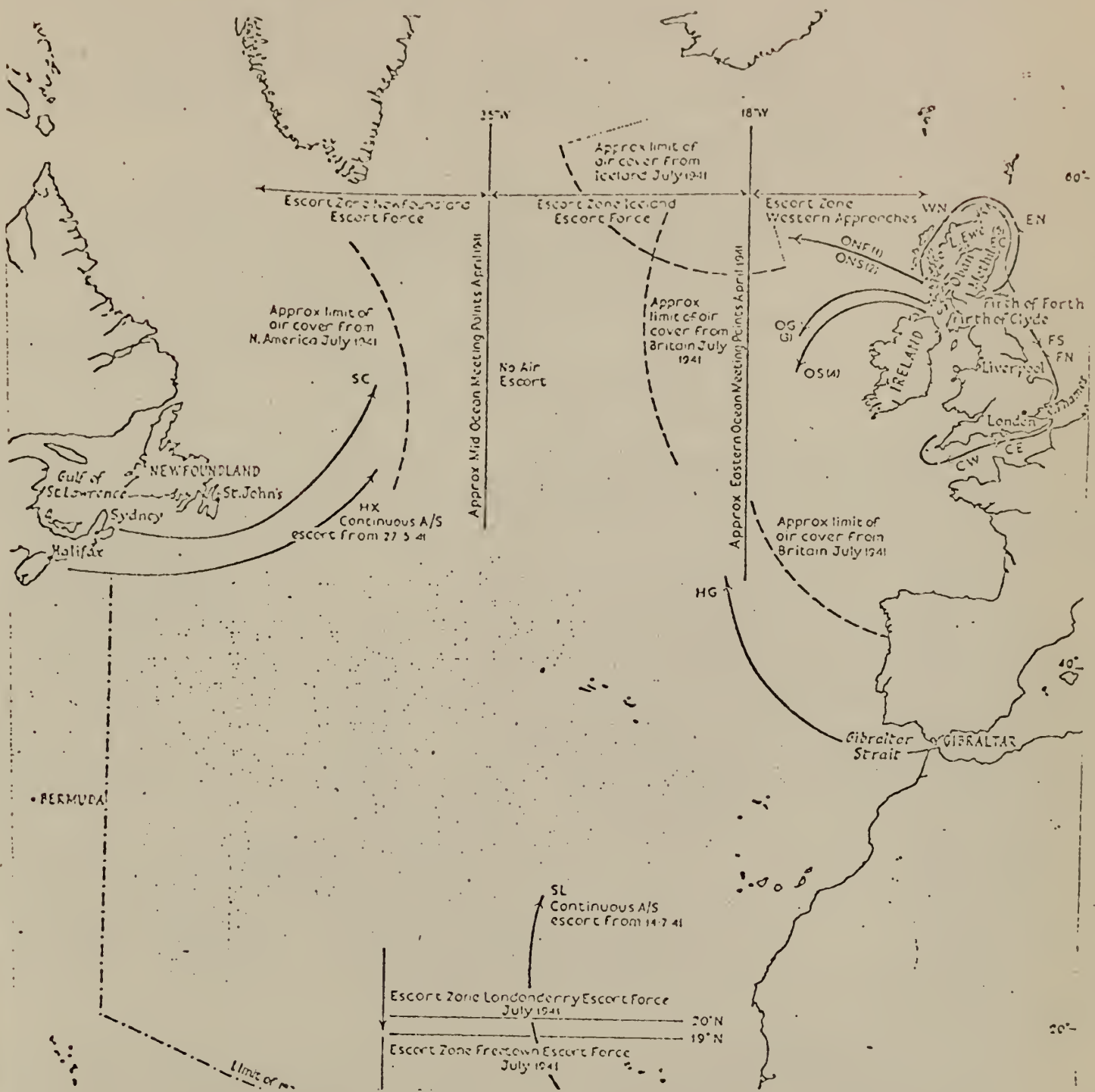
The U-boat had small potential for defensive action. In contrast to the envisioned role of the submarine before World War I, they sank few ships that were blockading the shores. They changed tactics and forced the superior naval powers to withdraw from close blockade. No longer was Great Britain able to blockade a fleet in port by remaining just outside the port. This change in tactics effectively ended all hopes of the submarines destroying the blockading force. At any rate during the Second World War submarines were offensive weapons; other weapons had offensive capabilities but none of the others were so powerful in one method of warfare and weak in the other.

problems of submarine operations and increase the ability of U-boats to penetrate the escort screen. The wolf-pack after the middle part of 1940 was virtually the only tactic of submarines until late in the war. From a technical view, Doenitz operated a brilliant offensive campaign. Whenever he found the defenses stiffening in an area he switched and attacked another undefended place. There were a number of difficulties with the wolf-pack system but it was the most effective method of employing submarines against convoyed merchant ships.

During the Second World War U-boat operations in the Atlantic constantly moved westward from England. After the entrance of the United States into the war, submarine attacks gradually moved eastward from the shores of North America. This left a relative concentrated area in mid-North Atlantic where most of the submarine attacks occurred. During the opening months of the war U-boats generally operated in the North Sea and along the Western Approaches. This was due in some small part to the limited range of U-boats and the inability to find targets in mid-ocean. As aircraft patrols became more effective with longer ranges and heavier loads the U-boats were forced to move constantly westward from the British Isles. Also the destroyer, which in the early months of the war was the primary anti-submarine vessel, did not have the range to cross the Atlantic on war patrol. Soon a gap formed off the southern coast of Greenland where neither airplanes nor escorts could cover the convoys. This area was known by various names during the war, "submarine alley," "black-hole," and the like. The map (VI-1) on the next page shows the areas, not only around Greenland, but around other major convoy routes, where the protection of traffic was impossible in 1941. The maps (VI-2, VI-3, VI-4, VI-5, VI-6, VI-7, VI-8, VI-9) at the end of this chapter show the varying locations of war losses during eight different periods. As the air gap between aircraft flying from the northern parts of England, Newfoundland,

Map VI-1 Principal Atlantic Convoys Routes and Zones of Close Anti-Submarine Escort, June 1940--December 1941

Limit of air cover in June 1941 shown by broken line.



Roskill, War at Sea, Vol. I, p. 456-7.

Iceland, and Azores gradually narrowed during the war, the entire path of the convoys was covered by air patrols. Part of the gap was closed by carriers operating in or near the convoys. As soon as smaller but longer ranged vessels, such as frigates and corvettes, became available, escorts began to accompany convoys clear across the Atlantic. Also during the war the techniques of mid-ocean refueling were refined until it became standard operating procedure. This in many ways allowed the escorts to accompany convoys throughout their entire voyage.

The submarine, even when attacking on the surface, stood a good chance of success against escorted convoys. Captain Walker, in his instructions to the 36th Escort Group, realized the danger from U-boats when he noted that it was not possible to completely protect a convoy from submarine attack.[1] The submarine's favorite method of attack in the Atlantic was at night on the surface. Riding on the vents with just the conning tower out of the water the submarine was very difficult to see.[2] While on the surface it could see both the targets which it was preparing to attack and keep an eye out for avenging escorts. In effect the submarine on the surface became another torpedo boat. The most striking difference was that rather than working in shallow coastal waters where movement was restricted the U-boat was stalking its prey in mid-Atlantic. Before the advent of radar U-boats on the surface were inconspicuous and a great deal more dangerous.

Another method, which must have been exceptionally unnerving, of evading the escorts was submerging and diving under the escorts and surfacing in the

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[1]Robertson, Walker, R. N., p. 37.

[2]The term "riding of the vents" was the naval term for being ready to quickly submerge. The submarine was only held up because the vent which allowed the air to escape from the tanks were closed. The valves at the bottom of the air tanks which allowed water to run in were open.

middle of the convoy. This greatly hampered the counter-attack. Not only did it make it difficult to determine where the attack was coming from, but the surfaced U-boat dodged in and around the merchant ships, firing torpedoes along the way, hampering the escort gunnery crews. Many times they could not fire for fear of hitting their own ships.

While the U-boat was a very suitable torpedo carrier it was unsatisfactory as a gun platform. Its very low freeboard and restricted field of vision limited its ability as a gun carrying weapon. Nevertheless, nearly all of the German U-boats carried a gun which was available for engaging surface targets.[1] When forced to the surface by depth charges the German submarine stood little chance of success against a more heavily armed escort.[2] A number of vessels were sunk either by guns or guns and torpedoes combined, but while the figures were not available, it seems certain that all the ships lost by submarine guns were sailing out of convoy. The figures were available to show that losses from submarines in which gunfire played a part were in the oceans that normally did not carry heavy traffic or away from the commonly used shipping lanes.[3] If the ships had been in convoy there was little doubt that the submarine would not have had time to sink a merchant ship with gunfire before the heavily armed escorts arrived. Against unescorted ships the submarine's guns cost a further loss of ships and

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[1]Doenitz, Ten Years and Twenty Days, p. 14.

[2]A. Cecil Hampshire, Lilliput Fleet: The Story of the Royal Naval Patrol Service, (London: William Kimber, 1957), p. 36, disagrees. According to Hampshire the trawlers stood little chance against the guns of a German submarine. This may be true with the lightly armed trawlers but against the four to six, 5-inch guns of a destroyer it was highly doubtful that the submarine lasted long. There was no mention in the official losses of the Royal Navy of a destroyer, corvette, or frigate being lost because of gunfire from a submarine

[3]Admiralty, British Merchant Vessels.

saved the submarine's torpedoes until a later date. The shelling of shore facilities in America shortly after the entrance of the United States into the war, while probably causing a sever case of jitters, was doubtful that it contributed greatly to the war effort.

So far most of the discussion on submarines operating in the mid-Atlantic has been on the operations against convoys. If the figures are correct, and there was no reason to doubt that they were not, the large majority of merchant ships lost were sailing independently.[1] This type of action on the part of the captains and officers who allowed their ships to sail without escort was courting disaster. Submarines stood very good chances of success against independent ships. The merchantman's guns were mounted on the rear of the ship and could not for the most part fire forward. Although there were a number of problems in attacking unescorted merchant ships submarines with their superior speed over the average tramp had only to gain a position in front of the ship and launch a torpedo. Ships sailing independently were usually found in areas where support was not readily available. A number of easy targets were found by submarines sailing more or less independently. Some merchant ships which were pressed into service because they were desperately needed in order to keep the British Isles supplied were not in the best condition. There were cases on record where merchant ships over fifty years old were used in convoys. These older ships could not keep up with the steady pace of the convoys and fell out of line because of mechanical failure and became stragglers. This made them particularly opportune targets for the submarines. Also, damage was suffered because of storms and other accidents or malfunctions which caused the merchantmen to fall back. Storms

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[1]S. W. Roskill, "Capros not Convoy: Counter-Attack and Destroy," USNIP Vol. 87, no. 10, October, 1956, p. 1052.

caused the convoys to scatter which made a larger number of easy targets, especially after the U-boats had been packing for an attack.

Ships sailing independently were more difficult to find if the submarine was looking for one particular ship. But since hundreds of ships were roaming the ocean in all sorts of different paths and directions a number of single ships were found by the submariners and consequently sunk. Convoys concentrated the ships and while a convoy was easier to spot than one particular ship a number of roaming ships were practically predetermined to run into a submarine somewhere.

The intensity of the U-boat campaign in the North Atlantic was shown by the losses of German submarines in this area. During the Second World War 218 out of 781 German submarines were lost in the North Atlantic. This listing did not include losses in areas such as south of Iceland, West Hebrides, Azores and the like, even though by geography these areas could properly have been called North Atlantic.[1] In no other single area were so many German submarines sunk. During the war 27.9% of the German submarines lost were sunk in the Battle of the North Atlantic. Most of these losses were in or around convoys. The losses of British merchant vessels also showed the intensity of the campaign. The British merchant shipping losses by submarine attack in the North Atlantic amounted to 3,332,856 tons.[2] During the war in all areas 5,991,139 tons of Empire shipping were lost because of submarine attack in deep water. The overall British losses of merchant vessels over 1,000 tons because of U-boats were 7,550,098 tons.[3] This figures out that 55.6% of the British merchant vessels over 1,000 tons were

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[1]Admiralty, German, Italian and Japanese U-Boat Casualties.

[2]Admiralty, British Merchant Ships. I have arbitrarily divided the North Atlantic for this figure into that areas which is bounded by 0° and 50° west and 40° and 70° north. This includes only those areas where the water is more than one hundred fathoms deep.

[3]Ibid.

lost because of submerged attack in the North Atlantic. Of the total British losses because of submarines in all areas 43.4% were sunk in the North Atlantic. This high rate of losses in one relatively small area showed how important the war in the North Atlantic was for the continued movement of supplies to Great Britain. After the U-boats were defeated in the North Atlantic in 1943 the losses of British merchant ships while grevious were not impossible to suffer. Many important attacks were made by German submarines in areas other than the one already mentioned, particularly along the coast of North America, but none were so important that the entire success or failure of the war depended on them.

All of the discussions of the offensive capabilities of submarines has so far been directed to deep water attacks. During three specific periods in the war the German submarine offensive moved to shallow water. The first of these periods was during the early months of the war before the British had time to organize their coastal defenses. The second was similar only during the early part of 1942. The German submarines then operated off the American coast before the United States had organized its defenses. The last period was shortly before and after the invasion of France.

While the submarines were able to operate close inshore during the early months of the war, the increasing number of escorts and anti-submarine vessels forced them to move to deeper waters. Also air cover over the water closest to English bases was a great deal more effective than over the far reaches of the ocean. The submarines were only able to come back to these shallow waters late in the war because of the invention of the schnorkel. This device, which was a breather tube for the diesel engines, allowed a submarine to charge its batteries while moving underwater. It stuck up like a periscope and drew fresh air

from the surface. This tube did not show much of a blip on the radar scope and allowed the submarine to remain underwater although at greatly reduced effectiveness.

During World War II, 1,558,959 tons of British merchant shipping were sunk by submarines in shallow waters, as compared with 2,569,093 tons because of attack by all other weapons in the German arsenal.[1] Axis submarines sank 60.06% of the British merchant vessels lost in shallow water. Therefore 39.94% of the vessels sunk in shallow water were lost because of aircraft, surface attack, mines and other weapons. Submarines were the most effective method of destroying commerce shipping in shallow water.

The Germans lost 145 U-boats in the shallow waters of the Atlantic Theater.[2] This figure, which was considerably lower than losses in Mid-Atlantic, does not accurately describe the situation during the war. For the larger part of the war the submarine did not operate in the narrow seas. During the first eight months of the war and from 1944 to the end of the war--with particular emphasis on the latter period--submarines operated in shallow water. There were 23 months in the period just mentioned. Also, there were 69 months in the whole war. If the 145 submarines lost during the 23 months that submarines worked in shallow water area were extrapolated to include the entire war (multiplied times three), 435 German submarines would have been lost in shallow water. This figure was still somewhat less than the 536 U-boats lost in non-shallow areas during the war. There was no evidence to support the view that had the submarines increased their efforts in the shallow waters no increase in losses would have occurred. Also, if the German U-boats had increased their efforts their high effectiveness

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[1]Admiralty, British Merchant Vessels.

[2]Naval History Division, U. S. Submarine Losses World War II, p. 159-74.

in shallow waters would probably have disappeared. This was because when U-boats moved into shallow waters they were always driven out after short periods. The campaigns in the inshore areas were sudden attacks and a method of keeping the enemy off balance, not a sustained offensive attack. In deep water 11,177.6 tons of British merchant shipping were sunk per submarine lost by the Germans. In shallow water 10,758.5 tons of British merchant shipping were lost for every U-boat destroyed.

The loss ratio for sinkings in shallow water dropped off considerably during the last months of the war. In the period from the start of 1944 to the end of the war 113 German submarines were lost. During the same period 177,388 tons of British merchant shipping were sunk by submarines. The ratio of tons sunk per submarine lost during this period was 1,568.8 sunk for every German submarine lost. It was evident by this time the U-boat menace was no longer a threat to British shipping but at no period during the war did German submarines present the problems in shallow waters that they did in the deeper waters of mid-ocean.

Practically every author who dealt with submarines as an offensive weapon noted some of the advantages which submarines found while operating in coastal waters off England.

Admiral Doenitz seemed surprised in his memoirs that the submarine really did have certain advantages when operating in shallow waters off coastlines.[1] Most of the advantages achieved by submarines were ones of increased difficulties of detection. In September, 1942, 122 attacks on U-boats were reported but many of them were on sunken objects.[2] This was during the height of the mid-ocean

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[1]Doenitz, Ten Years and Twenty Days, p. 425.

[2]Admiral Sir William Milburne James, The British Navies in the Second World War, (London: Longmans, Green and Co., 1946), p. 29.

campaign against submarines, so it was easy to see that even more mistaken attacks were made on sunken vessels in the shallow waters of the English Channel and North Sea. Theodore Roscoe in his work on the United States destroyers also noted that it was not uncommon to mistake a sunken wreck for a U-boat.[1] Most of the problems arose from inaccurately charted areas. A number of rocks throughout the war were thought to be submerged submarines and were repeatedly attacked. Also, even in areas where the ocean floor was charted accurately the tidal eddies caused confusion because they gave reflections on asdic sets similar to U-boats.[2]

The submarine also suffered hazards when operating in shallow water. The first of these was that it did not have room to maneuver as it did in the North Atlantic. In the ocean the submarine could go to any depth that its pressure hull could stand. In shallow waters the depth which the submarine could submerge was limited by the bottom of the oceans. This made it easier for escorts to set their charges because they knew that U-boats could not pass a certain depth. Shallow water in the Mediterranean allowed the submarines to be seen from airplanes. The clear waters of the Mediterranean could be seen to much greater depths (nearly four times as deep) as the murky waters of the Atlantic.

Throughout this section on offensive action with submarines only Axis, and particularly German attacks, have been described. The Royal Navy possessed a fleet of submarines but used them primarily in attacks on warships and were less concerned with commerce destruction.

When the war broke out in 1939 the Royal Navy and the German Navy had an equal number of submarines under their command.[3] Added to this number

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[1]Roscoe, U. S. Destroyer Operations, p. 78.

[2]Rayner, Escort, p. 221.

[3]Ruge, Der Seekrieg, p. 399.

was the French Force which exceeded even the British. Yet in few places were the British submarines as effective as German vessels for interdicting and nearly stopping commerce. The one area where they were particularly effective was against German and Italian supply lines in the Mediterranean.

The British success in the Mediterranean was caused by this being one of the few areas where success of a German offensive depended on sea transport.[1] Not only did Germany and Italy need supplies transported to their armies in North Africa, but for long periods of time the air forces in this area made it impossible for surface ships to operate effectively against enemy shipping. British submarines were somewhat safer from air attack than were surface ships. Marc Bragadin noted that of the 786 ships of 3,318,129 tons available to the Italian Navy in 1940, British submarines sank 324. This amounted to 25% of the Italian Navy merchant losses.[2] A larger portion of the Italian merchant marine was sunk by Allied aircraft. According to an article in the United States Naval Institute Proceedings in Mediterranean operations Allied submarines sank 1,041,570 tons of merchant shipping. They also sank four cruisers, eight destroyers, twenty-one submarines and nine other warships.[3] This figure was considerably higher than 25% of the shipping available to the Italian forces at the beginning of their war operations. A number of German controlled merchant vessels were sunk in the Mediterranean. It was difficult to determine the actual effectiveness of Allied submarines, primarily British, in the Mediterranean because there seemed to be

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[1]The exception to this statement was the attack on Norway, but the campaign was practically over before the sea power of Great Britain had a chance to intervene.

[2]Bragadin, Italian Navy in World War II, p. 364-66.

[3]John Gilbert Nigel, "British Submarine Operations in World War II," USNIP Vol. 89, no. 3, March, 1963, p. 79.

no accurate figures. Admiral Weichold, who commanded the German forces in the Mediterranean, noted that convoys to Africa in October 1941 were becoming more difficult for two reasons, aircraft and submarines.[1] He made no distinction between the effectiveness of the two different methods of attack, so it can be assumed that submarines were causing heavy losses to the German war effort. Malta in the Mediterranean played a vital role. It was a base for British submarines when the only other areas in the closed sea were Alexandria and Gibraltar. It allowed the submarines a base for refueling and rearming close to the Axis convoy routes to North Africa.

British submarines in the Atlantic were used in a totally different manner and apparently incorrectly. Kuenne stated that the British Admiralty viewed the submarine as only an anti-submarine and blockade weapon. The Mediterranean was the one place where they were allowed to prove their ability as commerce destroyers.[2] Using submarines to keep enemy warships from sailing or destroying them on their return to bases proved remarkably ineffective for both sides. The German light cruiser Karlsruhe which was severely damaged by a British submarine off Kristiansand, Norway, in April, 1940, was the only German war vessel larger than a torpedo boat lost to British submarines. It was so severely damaged that the Germans sank it.[3] At the same time German U-boats failed to find the carrier Ark Royal and the battle-cruiser Renown when they were returning from Freetown in October, 1940. U-boats were sent out on patrol with the special mission of sinking these two major warships.[4] The failure of the Germans to catch a pair

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[1]Weichold, War in the Mediterranean, p. 33.

[2]Kuenne, Attack Submarine, p. 4.

[3]Roskill, War at Sea, Vol. III, pt. 2, p. 457 and 461.

[4]Roskill, War at Sea, Vol. I, p. 131.

of capital ships should have pointed out to the British that using submarines for special operations against warships was impractical. During the First World War a number of capital ships were lost to submarines but these were for the most part in the very beginning of the war before the British understood how to avoid this type of activity. Had the Admiralty viewed this situation they might have decided that there were better methods of employing submarines. Throughout the war British submarines were stationed in the Atlantic where there was little German or Italian commerce to stop. Surface warships had for all purposes brought Axis overseas commerce to a halt. British submarines could have been much more effectively used in the Mediterranean where there was little room for evasive routing and plenty of targets for the submarines. Major warships were not particularly vulnerable to submarine attacks. Having the speed necessary to outdistance a submerged submarine and the gun power to sink a surfaced one easily, they were very difficult for submarines, in the Atlantic, to attack.

Most of the discussion of offensive capabilities of submarines has been on their ability to attack commerce ships. A special section of the problems of attack on warships needs to be included.

Perhaps the best known attack by a submarine on a capital ship was the sinking of Royal Oak in Scapa Flow by Gunther Prien in October, 1939. Not in any way detracting from the bravery shown by Prien the attack on the British Fleet's home base was due to a special set of circumstances not likely to be repeated. In one of the many passages to Scapa the defenses that were to protect the base from submarine attack were not completed. Prien managed to slip his submarine through a small hole in the defenses. It must be realized in October, 1939, that the defenses of Scapa were not finished and on war footing. Nevertheless the successful attack caused the British a severe case of jitters and for a time

they moved the fleet's anchorage to a safer but a less suitable location. Also Royal Oak was an old battleship completed in 1916 and while in harbor the ship was not prepared for attack. Large sections of the crew were on leave and water tight doors and other safety mechanisms were not functioning.

The other British battleship lost in the Atlantic Theater was Barham. This ship was a year older than Royal Oak and was sunk during operations off Sollum, Eygpt, in November, 1941. There was little known about her loss for a number of reasons. The first was that when struck by a German torpedo, she blew up and sank within two minutes. Also, the commander of the U-boat reported sinking a cruiser instead of a battleship and was sunk before he could file a complete report.[1]

A number of British carriers were lost during the war to submarines. The first was Courageous, completed in 1917 as a battle-cruiser and rebuilt in 1928 as a carrier.[2] While landing planes west of Ireland, she was sunk by a German submarine. She took two torpedo hits in the machinery rooms in September, 1939. Korotkin attributed her loss to weak underwater protection which can probably be explained by having been laid down in 1915 as a cruiser.[3]

The carrier Ark Royal, commissioned in 1939, was the first British carrier built as such. This carrier took one torpedo hit in the boiler rooms and due to a design error, water was able to run through the flues after the ship started to list. The pumps were able to handle the flow until after nearly making it to Gibraltar she was attacked by aircraft and sunk.[4]

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[1]Bragadin, Italian Navy in World War II, p. 144.

[2]Admiralty, Ships of the Royal Navy, p. 3.

[3]Korotkin, Battle Damage, p. 3.

[4]Admiralty, Ships of the Royal Navy and Korotkin, Battle Damage, p. 7-8.

Eagle was completed in 1924. Escorting a convoy from Gibraltar to Malta in August, 1942, she took four torpedo hits and after remaining afloat for some time finally sank.[1]

Two out of the three British escort carriers that were lost were sunk by submarine torpedoes. Audacity (11,000 tons) was lost in the North Atlantic on 21 December, 1941. Avenger (13,785 tons) was lost west of Gibraltar in November, 1942. The only other escort carrier lost in the Atlantic was Dasher which was lost because of a gasoline explosion west of Scotland.[2]

In the Atlantic during the Second World War eight British cruisers were lost to submarines.[3] This amounted to forty percent of the British cruisers lost in this area during the war. Practically all of the remaining cruisers were sunk by aerial attack. In order of the date of loss by submarine attack were: Calypso (12 June 1940), south of Crete; Bonaventure, (31 March, 1941), south of Crete; Dunedin (29 November, 1941), South Atlantic; Galatea (19 December, 1941), off Alexandria; Naiad (11 March, 1942), south of Crete; Edinburgh (2 May, 1942), Barents Sea; Hermoine (16 June, 1942), north of Sollum; and Penelope (18 February, 1944), Anzio. Very obviously cruisers were most vulnerable to submarine attack in the Mediterranean. This was due in large part to the fact that they were used to escort convoys both as close and long-range protection. When proceeding with the convoys they were more likely to be torpedoed because they were proceeding at slower speeds.

As already noted in table V-6 the losses of destroyers because of submarine attacks in the Atlantic amounted to 26.6% of the total British destroyers lost

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[1]Korotkin, Battle Damage, p. 9-10.

[2]Admiralty, Ships of the Royal Navy, p. 24.

[3]Ibid.

during the war. The losses of escort vessels amounted to 38.0% of the British escort ships lost. Submarines were the most deadly means of attack on escort vessels of all types.

Axis losses because of submarine attack were different than Allied. The German light cruiser Karlsruhe was the largest Nazi ship whose loss was attributed to a submarine. No German destroyers were lost because of Allied submarines and only two out of 56 torpedo-boats were lost because of submarines.[1] The submarine offensive against German warships was not effective. There were considerably fewer German vessels to be lost but the percentage figures of German warships lost because of submarine attack were so insignificant as to make small difference. The explanation for the difference between British and German losses because of submarines lay not only in the greater emphasis on them by German forces but also upon different strategies of employing surface forces. By refusing to sail the German Navy limited the effective methods of attack that could be used against it. Generally the only effective means of attacking German surface ships was through aerial bombardment while they were in port. While no comparative figures were available for the amount of time spent in port between the British and German Navies, it seemed sure that the British Navy spent more time at sea. Also, the British having superiority in surface ships preferred to use them to attack German surface vessels. Because of the small number of targets which appeared so infrequently the continued use of British submarines in the Atlantic Theater was a waste of effort. The Second World War showed that the value of submarines against warships was not very great.

The Italian losses because of submarines compared more effectively with British losses. During the war Italy lost three cruisers and 12 escorts to

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[1]Roskill, War at Sea, Vol. III, pt. 2, p. 457-461.

British submarines.[1] Only one of those cruisers was a heavy one. Trento was damaged by aircraft and sunk by a submarine east of Malta in June, 1942. The other two losses were the light cruisers Bandenere which was sunk off Strombili Island in April, 1942, and Diaz which was sunk off Tunisa in February, 1941. According to an article in the Naval Institute Proceedings only eleven and not twelve destroyers were lost because of submarine attacks.[2] Bragadin's work included all escorts and it was possible that only one smaller escort was lost by Italian forces. Using Bragadin's figures 50% of the Italian cruisers sunk were lost to submarines and 70% of the Italian destroyers lost were sunk by underwater craft. A larger percentage of Italian warships was lost because of submarine attack but they still were not as great numerically as those suffered by the British Navy. The same reason for the small number of Italian losses can be given as was given for the small number of German losses. The larger percentage of losses suffered by the Italians over the Germans was probably due to the increased sailing of the Navy and special characteristics of the Mediterranean. The factors include little room for evasive routing, normally good weather for aerial reconnaissance, and increased movement of ships.

4. Submarine effectiveness during the Second World War.

So far throughout this paper the submarine has been primarily studied as an offensive weapon. Its defensive ability was either non-existent or so severely limited that they have received comparatively little mention. During the invasion of France there was a heavy concentration of shipping close to the U-boat bases but they were unable to stop the invasion and caused few losses. The British

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[1]Bragadin, Italian Navy in World War II, p. 360.

[2]Navy Department Press Release, "Official Recapitulation of Italian Losses," USNIP, Vol. 72, no. 7, July, 1946, p. 1006-9.

submarine on occasion was used as convoy escort particularly for the Arctic convoys when there was a threat of action by surface ships.[1] No successes were recorded to this means of escort and some difficulties were probably experienced by the conventional escorts mistaking them for enemy submarines.

While the submarine used in a defensive manner caused few losses they did, during the First World War, rearrange the strategy of containing the enemy. The British could not afford to operate a close blockade against the German High Sea Fleet during the war because of the danger from both submarines and mines. Throughout centuries the British had closely blockaded enemy, particularly French, fleets. This strategy was now abandoned after the invention of submarines and mines; the Allies had to content themselves with the less effective, but safer, means of long range blockade from Scapa Flow. The phenomenon of great offensive and minimal defensive power was witnessed during the period between wars. Capt. Dewar of the Royal Navy recognized that the submarine's power of attack was great during the 1914 War but its defensive power, even in coastal waters, was small.[2]

Without any question the submarine in the hands of Germany was one of the most potent naval weapons during the Second World War in the Atlantic. The losses in all areas of the Atlantic far exceeded those caused by other means, and in the Atlantic as a whole far exceeded the combination of all means. During the entire war over 21,000,000 tons of Allied ships were sunk by all means. Of this 14,500,000 tons were sunk by submarine attacks on merchant shipping. The loss of men and material because of submarine attacks was phenomenal. By July, 1947, the insurance companies had paid out $217,000,000 with $50,000,000 in claims

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[1]See table III-5 which showed two submarines escorting convoy PQ 18 to Russia.

[2]Capt. C. Dewar, "Disarmament and Naval Policy," Brassey's, 1935, p. 69.

outstanding.[1] The purely monetary losses in no way showed the added suffering and losses caused by the armies combating Germany. Among other things the typical outgoing ship of 10,500 tons carried: 1,820 tons of munitions (bombs and shells), 1,555 tons of other stores, 88 trucks, 36 tanks, 48 cars (including both armored cars and jeeps), and 47 guns. This was not a complete listing because the ship carried cased gasoline and 5,000 tons of general stores wherever room could be found.[2] It would have been a major battle for the armies if they had lost the amount of armaments and munitions in a day that a single ship could lose by being torpedoed. John Creswell was not altogether uncertain that the submarine did not cost the Allies more effort than it did the Germans.[3] There seems to be no doubt that the underwater war was immensely expensive to the Allied cause. Germany with the investment of around a million tons of submarines caused the loss of 14 times their tonnage in merchant ships alone. Even granted that warships were a great deal more expensive to build, and submarines per ton were probably the most expensive of all, the phenomenal losses could not have been suffered by the Allies for a long time. Had submarines been easily defeated during the early months of the war the buildup of armaments and munitions in England for the cross-channel invasion probably would have taken place sooner than it did. It has, since Mahan, been the theory that guerre de course or raider war could not be more than a nuisance to the power commanding the sea. The submarine during the Second World War seems to have rearranged this. As in

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[1]C. H. Spilman, "The German Submarine War," USNIP, Vol. 73, no. 7, July, 1947, p. 683.

[2]Ministry of Information, Prepared for the Ministry of War Transport, Merchantmen at War, (London: HMSO, 1944), p. 64-5.

[3]John Cresewell, Sea Warfare, 1939-45, (London: Longman, Green and Company, 1950), p. 246.

World War War I submarines gave the inferior power in surface ships the ability to launch a counter-blockade. In discussing the effects of the submarine in the 1914 War, Brodie noted that because the submarine and other underwater weapons were available to inferior powers, which could launch a counter-blockade, the decision on the sea no longer went to the country with the superior navy. He predicted in the 1943 edition of Seapower that it might go to the country which had the least vulnerable means of communications.[1] There was no denying that Britain and other Allies won the sea war, but the war on both land and sea could not have been won until the submarine menace had been defeated. Had the loaders of the Jeune Ecole been able to predict the tremendous offense of submarines during World War II they would have been recognized as fortune-tellers. But their prediction about the ability of small weapons, submarines included, makes their views a great deal more credible than they had been viewed at the turn of the century.

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[1]Brodie, Seapower in the Machine Age, p. 328-9.

Map VI-2

Illustration of the Loss of U-Boats and Merchant Ships September 1939-May 1940.

o Merchant ships sunk
+ U-boats sunk

Admiralty, Battle of the Atlantic, p. 14-5

Map VI--3

Illustration of the Loss of U-Boats and Merchant Ships June 1940--Mid-March 1941.

o Merchant ships sunk
+ U-boats sunk

Admiralty, Battle of the Atlantic, p. 20--21.

Map VI-4

Illustration of the Loss of U-Boats and Merchant Ships Mid-March 1941-December 1941.

o Merchant ships sunk
+ U-boats sunk

Admiralty, Battle of the Atlantic, p. 28-9.

Map VI-5

Illustration of the Loss of U-Boats and Merchant Ships January 1942-July 1942.

o Merchant ships sunk
+ U-Boats sunk

Admiralty, Battle of the Atlantic, p. 40-41.

Map VI-6

Illustration of the Loss of U-Boats and Merchant Ships August 1942-May 1943.

o Merchant ships sunk
+ U-boats sunk

Admiralty, Battle of the Atlantic, p. 48-9.

Map VI-7

Illustration of the Loss of U-Boats and Merchant Ships June 1943-August 1943.

o Merchant ships sunk
+ U-boats sunk

Admiralty, Battle of the Atlantic, p. 66-7.

Map VI-8

Illustration of the Loss of U-Boats and Merchant Ships September 1943-April 1944.

o Merchant ships sunk
+ U-boats sunk

Admiralty, Battle of the Atlantic, p. 73-4.

Map VI-9

Illustration of the Loss of U-Boats and Merchant Ships May 1944-May 1945.

o Merchant ships sunk
+ U-boats sunk

Admiralty, Battle of the Atlantic, p. 88-9.

CHAPTER VII

SHIPS AS WEAPONS--
AN EVALUATION OF NAVAL WEAPONS

1. Introduction.

This final chapter attempts to draw together all the significant information presented in the foregoing body of the paper. Certain theories have been presented earlier and this chapter, while not specifically directed at these theories, attempts by implication to point out the failure during the Second World War of theory to conform with practice. The one area during the war where theory was implemented was in the employment of submarines. Admiral Doenitz's conception of wolf-packs was the one successful implementation of a pre-World War II theory. This failure of theories to conform with practice may have been caused because of a lack of this type study.

Throughout this paper no mention has been made on the morality, political implications, or usefulness of war. While questions of this nature are becoming more and more important to the military establishment, this paper is only an attempt to understand the effectiveness of certain weapons of naval warfare. Questions on the value and nature of war are exceedingly important but they should not overshadow the employment of weapons.

2. Battleships.

During the Second World War battleships proved that even though no longer the decisive weapons at sea they were still worthwhile for control of ocean lanes. Without question the battleship's guns had the power to destroy any surface ship which could be brought within range. The question of range became the whole

problem with the use of battleships during the last Atlantic war. Often Allied battleships could not engage even its own kind because the Germans, correctly recognizing their limited abilities with surface ships, were reluctant to sail their heavy ships without some measure of certainty that they would return. In the Mediterranean no decisive actions were undertaken by Italian capital ships. Seldom even in the Mediterranean did the heavy units meet and in all occasions these actions were indecisive. Some success was achieved by capital ships against lighter warships, but usually the destruction of the latter could be effected more satisfactorily by other means.

The airplane which was so popular during the period before the war, became an effective weapon because the Germans were reluctant to sortie their capital ships. It was interesting to note that Bismark was the only capital ship lost in the Atlantic by either side through aerial attacks at sea. All other German battleships were either destroyed in their ports by high level bombing or at sea by conventional means. Even though many Italian battleships were not permanently sunk, the attack on the Italian fleet at Taranto launched from aircraft carriers rearranged the strategic situation in the Mediterranean. It seems logical therefore that the effective use of aircraft when attacking battleships was not to attack them while at sea, but when they were in port. Aircraft gave the British Admiralty one advantage it had never possessed before. Prior to the advent of airpower the navy could only blockade ships in port. After aircraft became useful weapons of war they could not only blockade ships but destroy them while they remained in port. This was practically the exact reverse of the situation in the Pacific. During the Far Eastern War many Japanese capital ships were sunk at sea and the only major attack on a port was the surprise strike at Pearl Harbor. The predictions of the airpower enthusiasts before the war nevertheless

Table VII-1 BATTLESHIPS[1]

	ALLIED		AXIS	
	Battleships Sunk By Cause	Axis Ships Sunk By Allied Battleships	Axis Battleships Sunk By Cause	Allied Ships Sunk By Axis Battleships
Battleships	1	1½[2]	1½[2]	1
Cruisers	0	3	1	0
Destroyers	0	4[3]	0	0
Submarines	2	1[4]	0	0
Mines	0	?[5]	0	?[5]
Merchantships	0	?[5]	0	35
Aircraft	0	?[5]	4½[2]	?[5]

[1]Derived from Roskill, War at Sea, Vol. III, pt. 1, p. 379-380 and Vol. III pt. 2, 457-61 and p. 473, and Admiralty, Ships of the Royal Navy, and British an Foreign Merchant Vessels and German, Italian, and Japanese U-Boats Destroyed, an Navy Department Press Release, "Official Recapitulation of German Naval Losses," USNIP, Vol. 72, no. 7, July 1946, p. 1002-3 and Navy Department Press Release, "Official Recapitulation of Italian Naval Losses," USNIP, Vol. 72, no. 7, July, 1946, p. 1006-9, and Bragadin, Italian Navy, and American Warship Losses, an unpublished document possessed and drawn up by the Office of Naval History, Office of the Chief of Naval Operations.

[2]Half of the credit for the sinking of the German battleship Bismark has be given to aircraft.

[3]Eight German destroyers were sunk by the Warspite and other British destro during the Second Battle of Narvik and half of the credit has been given to the Warspite.

[4]Sunk by aircraft from the battleship Warspite during the Second Battle of Narvik.

[5]Information not available.

did not prove to be true in the Atlantic Theater. The battleships with their heavily armored decks and speed while at sea were extremely difficult targets for aircraft to hit, much less to sink. Also, battleships were deep water vessels which operated in the vast reaches of the oceans. By remaining long distances from the coasts the battleship reduced the threat of aerial attack. This was not possible in the Mediterranean but still in this area there were no battle ships lost from air attacks at sea. The planes that could attack the capital ships in mid-ocean either had to fly long distances from their bases on shore or from aircraft carriers. In either case they carried considerably lighter loads than land based bombers carried to inshore waters. The Atlantic Theater was strikingly different from the Pacific in this one respect; the influence of aircraft on surface ships was in port and not at sea.

While the greatest threat to German battleships was the airplane, the greatest danger to British capital ships was submarines. Two of the three British battleships lost were sunk by German submarines. While the loss of these ships did not upset the balance of power in the Atlantic it caused the British some serious losses which could not have been sustained for any length of time. Battleships, because of their vulnerability to submarines, absorbed large numbers of escort vessels to protect them from this type attack. These escort vessels could have been more usefully employed in convoy duties.

The greatest asset of battleships during the Second World War in the Atlantic was not what they did but what they could have done. The battleships which Germany possessed caused a severe dislocation of Allied forces. By playing the role of the "fleet-in-being" the Germans not only tied down large numbers of British battleships, but also the escort vessels needed to protect them. Their usefulness in this respect was noticed even by that arch-advocate of submarine

warfare, Admiral Doenitz, who, after he took command of the German Navy in January 1943, convinced Hitler that scrapping the battleships would have been unwise.

The battleship's usefulness during the Second World War in the Atlantic was not commerce raiding but the threat of commerce raiding. This tied down a large number of enemy forces, but this was a double-edged sword. In the years since the Second World War the battleship has passed out of sight because the means to attack them have developed greatly. Also, its effectiveness compared to other means of attack has decreased greatly. The proof of the danger to battleships lies not in the Atlantic Theater but in the Pacific. The battleship in the Atlantic during the Second World War was by no means the most effective weapon, but neither was it the least effective.

3. Cruisers.

Cruisers which Richmond argued for so strenuously before the war were probably the least effective warship during the war. Richmond was overly concerned about the threat of German pocket-battleships and merchant raiders. He thought large numbers of small cruisers would adequately protect the oceangoing commerce of Great Britain. The small cruisers which he advocated would have been able to combat disguised merchant cruisers which Germany from time to time sent on attack but a single heavy cruiser of nearly 10,000 tons with eight-inch guns could not defeat the heavily armed pocket-battleships.

The purposes of the cruiser according to Edward Altham were to scout for the battle fleet and to protect the sea lanes.[1] Before considering their effectiveness in this role one more type of employment should be discussed. During

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[1]Captain Edward Altham, "Cruisers," Encyclopedia Britannica, (Chicago: Encyclopedia Britannica, Inc., 1943), Vol. 6, p. 768.

peacetime cruisers sailed from port to port "showing the flag." This action was supposed to remind all nations of the strength of the navy using cruisers and the importance of sea power. In other words this type of action was a propaganda show. The tragedy of cruisers was that they were mostly show and little force. It seemed irresponsible for governments to place importance on cruisers for peacetime activity when they in fact had no power in war.

Returning to the cruiser's activity during war, it was a remarkably ineffective weapon. Admittedly it could protect the commercial sea lanes from attacks by some German surface raiders, but since one country's defensive weapons must be determined in a large part by the other's offensive weapons the construction of cruisers for this purpose was not worthwhile. The German commerce raiders of the type of the Graf Spee were relatively invulnerable to attack by British cruisers. The cruiser carried few if any depth charges or underwater weapons and was not a very efficient means of destroying German submarines. Scouting for the surface fleet was taken over during the latter part of the war by airplanes. Consequently the cruiser's effectiveness diminished. Airplanes could cover thousands of square miles from their higher altitude and faster speeds where cruisers could cover only that area which could be seen from the deck of a comparatively slow moving ship. The one advantage in scouting cruisers had over the airplanes was that they could remain on the scene for several hours, even days, as proved by the Bismark episode. Also, cruisers could be looking for targets when aircraft could not because of weather. But during the war, with the advent of airborn radar and other mechanisms, airplanes in the scouting role increased in effectiveness while the cruiser's role remained relatively unchanged.

The cruiser was vulnerable to nearly every type of attack that was employed. A number were sunk by mines and several were lost because of air attack during

Table VII-2. CRUISERS[1]

	ALLIED		AXIS	
	Cruisers Sunk By Cause	Axis Ships Sunk By Allied Cruisers	Axis Cruisers Sunk By Cause	Allied Ships Sunk By Axis Cruisers
Battle-ships	0	1	3	0
Cruisers	0	2	$\frac{1}{2}$[2]	0
Destroyers	0	8[3]	$2\frac{1}{2}$[2]	1[4]
Mines	1	?[5]	0	?[5]
Submarines	8	0	$3\frac{1}{2}$[6]	0
Merchant-ships	0	0	0	8
Aircraft	$6\frac{1}{2}$[7]	?[5]	$11\frac{1}{2}$[6]	?[5]

[1]Derived from Roskill, War at Sea, Vol. III, pt. 1, p. 379-380 and Vol. III pt 2, 457-61 and p. 473, and Admiralty, Ships of the Royal Navy, and British and Foreign Merchant Vessels and German, Italian, and Japanese U-Boats Destroyed, an Navy Department Press Release, "Official Recapitulation of German Naval Losses," USNIP, Vol. 72, no. 7, July 1946, p. 1002-3 and Navy Department Press Release, "Official Recapitulation of Italian Naval Losses," USNIP, Vol. 72, no. 7, July, 1946, p. 1006-9, and Bragadin, Italian Navy, and American Warship Losses, an unpublished document possessed and drawn up by the Office of Naval History, Office of the Chief of Naval Operations.

[2]Shared by cruisers and destroyers northwest of Crete, 19 August, 1941.

[3]Fologore shared by destroyers and cruisers 2 December, 1942, and Fulmine shared by destroyers and cruisers, 9 November, 1941. One-half credit has been given to each cause.

[4]HMS Glowworm sunk while ramming the German cruiser Hipper.

[5]Information not available.

[6]Trento was shared by aircraft and submarines June 15, 1942.

[7]The British cruiser York was shared by aircraft and an explosive motor boa 22 may, 1941.

operations around Crete. Cruisers were no more able to attack submarines than battleships and because they were smaller were more vulnerable to effects of torpedoes. During the 1914 War cruisers had been part of the battle line, but during the most recent war cruisers could not withstand the impact of the battleships and were usually withdrawn until the fighting was over. This does not mean that cruisers never fought battleships. When they did it was usually only to protect a convoy and against a determined and skillfully led force of battleships, cruisers stood a very good chance of being destroyed.

Cruisers, during various periods in the war, played the role of commerce destroyers and "fleets-in-being" because they could sink a large number of merchant ships if they found an unescorted convoy. British cruisers in the Mediterranean and German cruisers in the Atlantic were employed in just such roles but in neither area were they the most deadly forms of attacking merchant fleets.

During the Second World War in the Atlantic cruisers were neither the most effective means of protecting nor destroying commerce, nor were they an efficient means of scouting for the fleet. Cruisers could not compete with battleships, and were easily destroyed by other means of attack. During the last war, cruisers, even more than battleships, proved their ineffectiveness as a weapon of naval warfare.

4. Escorts.

Destroyers and other escort vessels which were overlooked during the period between the wars proved to be some of the most valuable weapons in the Allied naval arsenal. Without destroyers the heavier, and supposedly more powerful ships of the fleet, were defenseless. It seemed evident, though the fact was often overlooked, that defense requirements of one country were primarily decided by the offensive capabilities of the supposed enemy. Since the submarine had been

Germany's destructive naval weapon in World War I, the method by which these craft could be counter-attacked should have been the primary consideration of the British Naval Staff during the interwar years. The Admiralty was perhaps too much imbued with Mahan's philosophy which declared that a war against commerce could not be successful. As was so often evident in these matters, the only thing they concerned themselves with was the easy problem of defeating the enemy's surface forces with their correspondingly heavier surface forces. The Admiralty and some of the naval writers of the period between the wars (primarily Richmond) spent a great deal of thought developing the counter-attack method necessary to destroy the German Navy's surface vessels. Little effort was spent considering how submarines could best be destroyed. Part of the sense of security may have arisen from over-confidence in the abilities of underwater detection gear and a failure to correctly predict the tactical plans of future operations with submarines.

During the early period of the war escorts were, without question, the most effective means of destroying submarines and consequently protecting commerce. During the latter half of the war it was necessary to share the honors with aircraft, but while the kills of submarines by escorts alone fell, the value of escorts as commerce protectors remained stable. With the increase of available escorts, convoys were sufficiently protected and hunter-killer groups were organized. The close escort of convoys was probably the more valuable method of employing escort vessels even though the latter method had much to recommend it. Escorting convoys was purely a defensive measure which made it difficult for submarines to attack their targets. If submarines had withdrawn from attacking convoys, few of them would have been destroyed. This retreat would have accomplished the immediate task of protecting the ships from submarines. On the other hand,

Table VII-3. ESCORTS[1]

	ALLIED		AXIS	
	Allied Destroyers Sunk By Cause[2]	Axis Ships Sunk By Allied Destroyers	Axis Destroyers Sunk By Cause	Allied Ships Sunk Because of Axis Destroyers
Battle-ships	3	0	4[3]	0
Cruisers	1[4]	½[10]	8[5]	0
Destroyers	10	14	14[3-5]	0
Submarines	59	30 8½[6]	7[11]	17
Mines	31	?[7]	9[8]	?[7]
Merchant-ships	0	?[7]	0	0[9]
Aircraft	52	?[7]	27	?[7]

[1]Derived from Roskill, War at Sea, Vol. III, pt. 1, p. 379-380 and Vol. III, pt. 2, 457-61 and p. 473, and Admiralty, Ships of the Royal Navy, and British and Foreign Merchant Vessels and German, Italian, and Japanese U-Boats Destroyed, and Navy Department Press Release, "Official Recapitulation of German Naval Losses," USNIP, Vol. 72, no. 7, July 1946, p. 1002-3 and Navy Department Press Release, "Official Recapitulation of Italian Naval Losses," USNIP, Vol. 72, no. 7, July, 1946, p. 1006-9, and Bragadin, Italian Navy, and American Warship Losses, an unpublished document possessed and drawn up by the Office of Naval History, Office of the Chief of Naval Operations.

[2]The losses for Allied destroyers include not only destroyers but also frigates, sloops and corvettes.

[3]Eight were sunk during the Second Battle of Narvik, April 13, 1940, but because of the presence of the battleship Warspite only one-half credit has been given for each of the destroyers lost during this battle.

[4]Glowworm sunk while ramming the German cruiser Hipper, 8 April, 1940.

[5]Fologore (2/12/42) and Fulmine (9/11/41) shared by cruisers and destroyers; half of the credit has been given to each.

[6]Forty-six German submarines were shared with aircraft and only half credit has been given to the destroyers. Five Italian submarines were shared between escort vessels and only half the credit has been given to the escorts.

Table VII-3 continued.

[7]Information not available.

[8]On February 20, 1940, two German destroyers were attacked by accident by German aircraft and ran into a British minefield while taking avoiding action.

[9]Since this listing only includes those ships over 1,000 gross tons none have been recorded as having been lost because of Axis destroyer attacks.

[10]Colleoni shared by cruisers and destroyers northwest of Crete.

[11]According to Roskill, War at Sea, and Bragadin, Italian Navy, the Italian destroyer Libeccie was sunk by a submarine 11 September, 1941. According to the official recapitulation of losses for the Italian Navy it was sunk in a surface action the same day.

submarines of sufficient range would have been able to renew the attack when escorts were withdrawn from the convoys. Hunter-killer groups were more effective at removing the threat to convoys. They had the ability to destroy submarines in any local. Also, they kept the pressure on the submarine crews. If the first task was to sink submarines, hunter-killer groups should have been emphasized. If on the other hand the primary duty of escort vessels was commerce protection, it was proper to place the primary emphasis on close escort of convoys. Once enough vessels were present to satisfactorily accomplish both jobs then groups which hunted submarines were warranted.

As was obvious, from the chart concerning the loss of destroyers, the greatest threat to British escort craft was Axis submarines. This was logical because their duty was to hunt down these submarines and they were consequently in close contact with them. The second most successful weapon against Allied escorts was aircraft. This was true because destroyers did not have the heavy armor and anti-aircraft armament which their larger brethern possessed.

Axis destroyer losses were just about equally divided between surface attack and aerial attack which brought up an interesting question. Most of the destroyers lost by surface action were German destroyers in the Atlantic. Most of the destroyers lost by aerial attack were Italian vessels in the Mediterranean. This seemed to indicate that against small vessels the Mediterranean was the more opportune area for air power to exert its force. Also, it seems to show that while the German battleships were content to remain in harbor and be steadily destroyed by aerial attack, the lighter, and more expendable craft, were out challenging Allied inshore traffic.

While naval leaders complained of a shortage of destroyers, they were expendable and used for many non-vital tasks. Capital ships were too valuable to

be risked on many of the jobs that destroyers were given. This included commando raids and other hazardous operations. Thus it seemed that destroyers could perform nearly any task and still be prime surface weapons to destroy the attackers of British commerce, U-boats. Destroyers could perform any job on a version scaled down to fit its size that the heavier ships, except aircraft carriers, could do. Destroyers, one of the small weapons of the Jeune Ecole, were without doubt the most useful and important of the surface weapons used in the Atlantic during the last war by the Allied navies.

5. Submarines.

Submarines, which because of the nature of the German naval position were their primary naval weapon, were in terms of Allied ships sunk the most successful naval weapon of the war. The offensive capabilities of this weapon, which was not new and had more or less shown its abilities in the 1914 War, had been ignored by the great sea powers during the period between the wars. This was due in large part to a misunderstanding about the operational qualities of the new German U-boats. A sense of security about the threat which these weapons presented was developed in England during the long armistice. Because of the development of electronic detecting gear it was thought that submarines were no longer effectively able to destroy large amounts of Allied merchant shipping.

Submarines, like all other weapons mentioned so far in this summary chapter, exerted their greatest influence in the deep waters of the mid-Atlantic. Even though large numbers of merchant ships were sunk in the shallow waters off England and the United States, by far the largest number were sunk in deep waters. This phenomenon may be partially explained by methods of hunting submarines in shallow water. Offensive patrols hunting submarines in shallow water were in areas where traffic was thickest and had the effect of convoying the merchantmen into port.

If tho ships were attacked on their passago through coastal waters, very often there was an escort nearby to come to their aid. Even with additional new inventions the submarine's greatest offensive threat was in the mid-Atlantic.

Submarines while remarkably well adapted to destroying merchant ships were not particularly well suited for sinking warships. This was because warships had sufficient means of defending themselves. Even in this field they achieved some notablo successes, sinking two Allied battleships and eight cruisers. Part of the explanation for the Axis success against Allied warships was found in the increased numbers of Allied ships at sea. The Allied submarino effort against Axis warships did not prove as successful. In neither case was tho submarine a valuable weapon against warships. Allied warships sunk by submarines can best be described as targets of opportunity.

The submarine's greatest enemy was either aircraft or escorts depending on the period of World War II under consideration. Until the middle of 1943, escorts were practically tho sole method of destroying Axis submarines. After this aircraft, which had been equipped with radar and longer range, superceded escorts in effectiveness and destroyed larger numbers than escorts had during the earlier years of the war. In the 1914 War mines had destroyed nearly as many submarines as escorts, but during the war their role was drastically reduced because of changes made in where German submarines could escape to the ocean.

6. Mines.

The major influence of mines during the Second World War in the Atlantic was not so much what they did, but what they denied the enemy the ability to do. The mine was the one weapon which unless destroyed closed an area during all types of weather and throughout the full year. This was because mines were different in one essential respect from other weapons of naval warfare which

Table VII-4. SUBMARINES[1]

	ALLIES		AXIS	
	Allied Submarines Lost By Cause	Axis Ships Sunk By Allied Submarines	Axis Submarines Sunk By Cause	Allied Ships Sunk By Axis Submarines
Battle-ships	0	0	1[4]	2
Cruisers	0	3	0	8
Destroyers	17	11	308½	59
Submarines	4	40	40	4
Mines	22	?[3]	38½[6]	?[3]
Merchant-ships	0	104[2]	0	1,209
Aircraft	4	?[3]	329[7]	?[3]

[1]Derived from Roskill, War at Sea, Vol. III, pt. 1, p. 379-380 and Vol. III, pt. 2, 457-61 and p. 473, and Admiralty, Ships of the Royal Navy, and British and Foreign Merchant Vessels and German, Italian, and Japanese U-boats Destroyed, and Navy Department Press Release, "Official Recapitulation of German Naval Losses," USNIP, Vol. 72, no. 7, July 1946, p. 1002-3 and Navy Department Press Release, "Official Recapitulation of Italian Naval Losses," USNIP, Vol. 72, no. 7, July, 1946, p. 1006-9, and Bragadin, Italian Navy, and American Warship Losses, an unpublished document possessed and drawn up by the Office of Naval History, Office of the Chief of Naval Operations.

[2]This figure is only those Axis ships which were lost in the Home Theater.

[3]Information not available.

[4]Sunk by aircraft from HMS Warspite.

[5]Forty-six German submarines and five Italian submarines were shared between escort vessels and aircraft and only half credit has been given to escort vessels.

[6]One submarine was shared between mines and aircraft.

[7]Five Italian submarines which were shared (see footnote five) with surface craft and the one shared with mines accounts for the whole number instead of one-half.

have been discussed in this paper. Battleships and other surface craft, submarines, and aircraft were all just delivery systems. The destroyer's purpose was to deliver depth charges accurately; the battleship's high explosive shells; the aircraft's bombs and torpedoes; and the submarine's torpedoes. The mine itself was the weapon. The mine did the destruction whereas other weapons only delivered shells, torpedoes, or bombs. This, of course, pointed out one of the main handicaps of mines. The target, with few exceptions, had to come to the mine and not the other way around.

It was interesting to note that the Germans achieved much less success with their mines than Allied powers. This phenomenon was partially explained by the success of the British in discovering the principle by which the Axis magnetic mines were detonated and consequently developing sufficient countermeasures. Since this explanation is only partial, other reasons must have played a part in the success of the British minelaying campaign. Part of the explanation of the phenomenon lied in the statistics themselves. The losses of Allied ships because of mines listed only those ships which were over 1,000 tons. In Roskill's listing all types and sizes of Axis vessels were included.[1] Even though the Allies lost fewer ships their tonnage sunk was greater than the German tonnage lost because of mines. The Axis powers in the Home Theater lost 660,533 tons of merchant shipping to the Allied total of 857,611 tons.[2] Therefore, it seems logical that the table was partially in error but the figures that Roskill gave were the only ones available.

Few warships were sunk by mines as compared with other means but this was perhaps not mines primary purpose. The mine attack against warships was directed

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[1]Roskill, War at Sea, Vol. III, pt. 2, p. 473.

[2]Ibid. and Admiralty, British and Foreign Merchant Vessels.

Table VII-5. MINES[1]

ALLIED		AXIS	
Allied Mines Destroyed By Cause[2]	Axis Ships Sunk By Allied Mines	Axis Mines Destroyed By Cause[2]	Allied ships sunk By Axis Mines
Battleships ?	0	?	0
Cruisers ?	0	?	1
Destroyers ?	20	?	31
Submarines ?	34½[3]	?	22
Mines 0[5]	0[5]	0[5]	0[5]
Merchantships ?	604[4]	?	199
Aircraft ?	0[5]	?	0[5]

[1]Derived from Roskill, War at Sea, Vol. III, pt. 1, p. 379-380 and Vol. III, pt. 2, p. 457-61 and p. 473, and Admiralty, Ships of the Royal Navy and British and Foreign Merchant Vessels and German, Italian, and Japanese U-Boats Destroyed, and Navy Department Press Release, "Official Recapitulation of German Naval Losses," USNIP, Vol. 72, no. 7, July, 1946, p. 1002-3, and Navy Department Press Release, "Official Recapitulation of Italian Losses," USNIP, Vol. 72, no. 7, July, 1946, p. 1006-9, and Bragadin, Italian Navy, and American Warship Losses, an unpublished document possessed and drawn up by the Office of Naval History, Office of the Chief of Naval Operations.

[2]These columns are rather meaningless. There is no published record covering the entire war which gives the number of mines destroyed according to the method by which they were detonated or otherwise rendered inoperable but certain lower limitations could be placed on the number destroyed. For example unless two Allied merchant ships were sunk by the same mines it is possible to assume that 604 mines were exploded by merchant ships. The problem arises when it is understood the many times the striking or detonating of a mine did not sink the ship.

[3]One was shared between aircraft and mines.

[4]In Home Theater only.

[5]It is highly doubtful that any aircraft were destroyed by mines as it is doubtful that any mines were destroyed by mines but not entirely impossible. If an aircraft was flying at low altitude with a magnetic device to detonate mines the blast could possibly destroy the aircraft. In any case the figures are not available.

in changing their movements and denying them certain passages to open seas. Also mines forced enemy ships into certain passages where they were more vulnerable to other means of attack. Mines were supposed to play a major role in stopping the invasion of France during 1944, but were uncessful. Part of the explanation for their failure was due to Hitler's unwillingness to allow the sowing of new pressure mines and part was due to the extensive Allied sweeping measures. It also seems that mines were effective against single ships or in denying passage to a few important vessels. When an enemy was determined to force a passage through a small area their effectiveness diminished. In part this was because leading ships set off the mines and consequently were sunk, while the following ships were then assured a safe passage through the fields. Also, during the last war mines in large defensive fields were remarkably unsuccessful. The most remarkable failure was the Iceland-Faroes Passage. The mine which had commonly been viewed throughout the Twentieth Century as a defensive weapon had become a major offensive weapon in a guerre de course.

7. Merchant Ships.

Merchant ships, usually peaceful carriers, could hardly be called weapons of war except in one sense; they supplied all offensive and defensive weapons of countries which depended solely on their use. It may well be that the warships controlled the oceans, but if a country such as England could not import and export supplies the warships became useless masses of metal which could not play a part in the war at sea. Mahan was throughly convinced that while the merchant marine was one of the assets of sea power, an enemy whose primary purpose was to attack merchant ships would more than likely lose the war. Warships, powerful and destructive as they were, would have been totally helpless without the support and munitions which the merchantmen brought to them and their country. Since

the merchant vessels could not adequately protect themselves, it was necessary for warships to protect them.

Some countries could more easily do without a fleet since they did not necessarily need the commerce which came in from overseas, but for those whose ability to make war was determined by the amount of overseas transport the merchant fleet and the military fleet were closely connected.

8. Aircraft.

The air power advocates predicted that a country could easily be destroyed by strategic bombing. The Second World War seems to have disproved this theory. The effect of strategic bombing did not become apparent in German submarine construction until the end of 1944. There was no telling how many more submarines would have been built had there never been a strategic bombing campaign against Germany, but there was no let up in production until nearly the end of the war. Other factors, such as occupation of the production facilities by the advancing armies could have just as easily influenced the decrease in U-boat construction. Air power enthusiasts were also proven wrong when Hitler failed to conquer England purely through the use of aircraft. If men like Douhet and Trenchard had been correct in their interpretation of the ability of air power to dominate, there would have been no need for a navy or a naval war. The essential thesis of many of the surveys of strategic bombing after the war was how the advocates of strategic bombing had overstated their claims.

Aircraft in the undetermined field between strategic and tactical bombing did prove their value when correctly applied. This field in the naval theater was the bombing of ports and harbors in attempts to destroy ships that were already completed there. Admittedly they were unable to sink Scharnhorst, Gneisenau, and later Prinz Eugen, but they did manage to keep them immobilized for a

Table VII-6. AIRCRAFT[1]

	ALLIED		AXIS	
	Allied Aircraft Lost By Cause	Axis Ships Sunk By Allied Aircraft	Axis Aircraft Lost By Cause	Allied Ships Sunk By Axis Aircraft
Battleships	?[2]	4½[4]	?[2]	0
Cruisers	?[2]	11½[5]	?[2]	6½[7]
Destroyers	?[2]	27	?[2]	52
Submarines	?[2]	329[6]	?[2]	4
Mines	0	?[2]	0	?[2]
Merchantships	?[2]	509	?[2]	267
Aircraft	?[3]	?[3]	?[3]	?[3]

[1]Derived from Roskill, War at Sea, Vol. III, pt. 1, p. 379-380 and Vol. III, pt. 2, 457-61 and p. 473, and Admiralty, Ships of the Royal Navy, and British and Foreign Merchant Vessels and German, Italian, and Japanese U-boats Destroyed, and Navy Department Press Release, "Official Recapitulation of German Naval Losses," USNIP, Vol. 72, no. 7, July 1946, p. 1002-3 and Navy Department Press Release, "Official Recapitulation of Italian Naval Losses," USNIP, Vol. 72, no. 7, July, 1946, p. 1006-9, and Bragadin, Italian Navy, and American Warship Losses, an unpublished document possessed and drawn up by the Office of Naval History, Office of the Chief of Naval Operations.

[2]Information not available.

[3]While the losses of aircraft because of other aircraft are available, they do not tell whether the aircraft lost were lost in attacking naval targets or other operations.

[4]Half of the credit for the sinking of Bismark has been given to aircraft.

[5]Trento was shared between aircraft and submarines, 15 June, 1942.

[6]Five Italian submarines were shared by ships and aircraft and another was shared with a mine which allowed for the whole number of submarines lost.

[7]York was shared between aircraft and an explosive motor boat, 22 May, 1941.

long time. Finally they were forced by aircraft to make the reckless dash up the English Channel. A large number of submarines were destroyed while still tied to their docks. In this manner aircraft contributed significantly to the successful conclusion of the sea war by the Allies.

The final and most successful employment of aircraft was their use in hunting down submarines at sea. Whether they were employed in convoy escorts or hunter-killer groups made little difference. Once aircraft were equipped with 10 cm. radar and a satisfactory method of attacking submarines, they achieved notable successes. In this and virtually all types of employment dealing with sea power aircraft, the archetype offensive weapon, was acting in a semi-defensive manner.

Aircraft were best used in a tactical manner. While numerous groups argued throughout the war for the increasing employment of aircraft in attacks on German industry instead of combating U-boats, all these strategic attacks were a detriment to the British naval effort. Perhaps the Axis military effort could have been ruined had the strategic offensive been given sole attention, but it was very likely that the war would have been lost long before then. It was absolutely mandatory for England to maintain its lines of communication with the United States and the Empire in order to insure her continued war effort. While attention was being given to destroying the Axis war economy, England, given proper circumstances, might have been starved into surrender. The airplane which could not effectively destroy the ships which theorists had predicted, was more than adequate in destroying the one weapon which naval writers had ignored, submarines. Once submarines had been defeated and British lines of communication secured, increasing attention could be paid to the German war economy. But it was first necessary for aircraft to be employed against that form of attack which most threatened Allied communications.

Carriers during the war in the Atlantic did not become the "Queen of Battle" as they had in the Pacific. They were used with great effectiveness to track down battleships. So seldom were they employed in this activity that their importance was more of a threat than an actuality. They were also methods of taking planes to the areas where submarines were concentrating. This was due to the fact that in some areas long range aircraft could not patrol. Carriers' power was minimal without aircraft and by themselves were vulnerable to other forms of attack.

Aircraft during the Second World War became another factor in naval power which needed to be reckoned with. Their influence was greater than some and not as great as others had predicted.

9. Conclusion.

Throughout this chapter and the tables included in it (VII-1, VII-2, VII-3, VII-4, VII-5, VII-6) it will be noticed that there were six types of weapons that could sink ships; battleships, cruisers, destroyers, submarines, mines, and aircraft and conversely there were five types of ships that could be sunk; battleships, cruisers, destroyers, submarines and merchant ships. In each class of ship that could be sunk the most effective weapon for that class had been given an arbitrary score of six points, the next more effective five points and so on until the least effective was given one point. A number of times certain weapons had to share the honors as to the position into which they fell. For example if battleships, cruisers, and destroyers tied for fourth, fifth and sixth places the total number of points left was prorated among them. In this example the three weapons received two points each. By employing this method an arbitrary way of determining the effectiveness of weapons has been reached. The total number of points available was 105 but no single weapon could receive more than thirty points.

Allied weapons in terms of their relative effectivoness against Axis ships were: aircraft first with 29 points, submarines and destroyers tied for second with 17 points each, mines fourth with 16 points, battleships fifth with 14 points, and cruisers last with 12 points. This showed that for the defense of the British Empire and the other Allied communications aircraft were by far the most effective weapon used by the Allies in the Atlantic during the Second World War. The tie between submarines and destroyers was most unusual because it has been assumed that the submarine was an Axis weapon and the destroyer an Allied one. The situation of equality arose because destroyers were remarkably effective at sinking submarines but apparently useless for sinking other types of craft. Submarines on the other hand were valuable for a few cases, but unlike destroyers were useful in attacking other types of ships besides merchant ships. Mines, battleships, and cruisers were all so close together that not many meaningful judgments can be made about them without encountering the difficulties of relative effectiveness in the targets that were being attacked.

Axis weapons in terms of relative effectiveness against Allied ships were: first submarines with $27\frac{1}{2}$ points, aircraft second with 21 points, mines third with $20\frac{1}{2}$ points, destroyers fourth with $13\frac{1}{2}$ points, battleships fifth with $11\frac{1}{2}$ points, and cruisers last with 9 points. Submarines turned out to be the most effective weapon in the Axis naval aresnal. Next came aircraft, then mines which were supposed to be Hitler's secret weapons came in a close third. The next three weapons in order of the effectiveness were destroyers, battleships, and cruisers.

By adding the two scores for the Axis and Allied weapons a figure which depicted the entire war was derived. Aircraft came in first with 50 points, submarines second with $44\frac{1}{2}$ points, mines third with $36\frac{1}{2}$ points, destroyers fourth with $30\frac{1}{2}$ points, battleships fifth with $25\frac{1}{2}$ points and cruisers last with 21 points.

Those conclusions showed that a number of theories about the conduct of naval war were correct. In general the theories supported by the evidence were those of the Jeune Ecole. Only one of the three leading weapons--aircraft--had been seriously studied during the period between the war. A number of faults in the ideas of the airpower pundits can be pointed out but for the most part these were errors of emphasis. Admiral Doenitz of the German submarine arm seemed to have been one of the few naval intellectuals that had correctly applied the lessons of the First World War. Mines as weapons of naval warfare had been ignored by practically all parties in their strategical and tactical studies.

In the introduction it was suggested that the theories of the Jeune Ecole had supplanted those of Mahan. The creation of weapons which either did not exist at the time of these two schools or were only in their rudimentary forms changed the nature of sea warfare dramatically. No longer could naval war be fought in two dimensions--Mahan described the sea as a broad plain--but small weapons which operated in three dimensions changed significantly the nature of naval war during the Second World War. The First World War was the great finale of two dimensional warfare. Hitler's war may have ushered in a new era of three dimensional combat. It may be necessary to view war differently and the evidence of the theories between the wars seems to support the observation that naval theorists did not understand the complex changes caused by the change in the nature of battle.

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Before beginning the list of sources used for this paper it should first be mentioned that I received considerable help from various official organizations. The Office of Naval History under the direction of Rear Admiral E. M. Eller allowed me to see a classified document that has not been published. This document was an IBM computer sheet giving longitudinal and latitudinal listing of American warships and merchant ships lost by cause. This listing was immensely valuable for certain studies particularly the concluding chapter. Also, the Admiralty Historical Office under the direction of Lt. Cmdr. Peter Kemp was good enough to allow me to see a similar document concerning British merchant ships. The staff of the Eisenhower Library loaned me the use of their facilities in order that I could see these classified documents. The help which was given to me by official organizations was of the greatest value in preparing this paper.

A short note is also necessary for an understanding of the subdivisions of this bibliography. The traditional subdivisions of primary and secondary sources have been ignored in favor of dividing the books along lines of official histories and personal accounts. Personal accounts also include many times general accounts by officials who took part in the naval actions of the Second World War. This has only been done when the book was primarily concerned with their activities.

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This work was valuable because it included in the appendix a new and revised listing of German submarines sunk during the war by cause and location.

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The conferences were a most useful and interesting collection of documents relating to the higher direction of the German naval effort. It not only included discussions about strictly naval matters but production and even grand strategy.

Office of Naval Intelligence. German Naval Air, 1933-1945: A Report Based on Naval Staff Documents. Washington, D. C.: Office of Naval Intelligence, 1947.
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This essey, part of the Tambach Documents which have not been fully translated and published, was of great value. Admiral Weichold commanded the German naval forces in the Mediterranean and this document was particularly objective for someone who had just been captured. While he hold a definite preference for the Mediterranean Theater this is still controversial and should not be held against the essey.

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The lack of French naval activity during the last war inhibited this work.

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Bragadin, Marc Antonio. The Italian Navy in World War II. Trans. Gale Hoffman. Annapolis, Maryland: United States Naval Institute, 1957.
Bragadin gave a more favorable interpretation of the Italian naval effort during the Second World War than have most British and American historians.

Collier, Basil. The Defense of the United Kingdom. London: HMSO, 1957.
This history while valuable for other reasons was worthwhile for this paper because it showed how the economy was dependent on merchant shipping.

Frankland, Noble and Webster, Sir Charles. The Strategic Air Offinsive Against Germany, 1939-1945. 3 vols. London: HMSO, 1961.
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Herington, John. Air War Against Germany and Italy, 1939-1943. Vol. III. Ser. III. Canberra: Australian War Memorial, 1962.
This dealt primarily with the Australian effort against the Axis powers.

Richards, Denis. Royal Air Force, 1939-1945. Vol. I. London: HMSO, 1953.
This work and its companion volume dealt not only with strategic attacks but with all aspects of aerial warfare performed by the Royal Air Force in World War II.

Richards, Denis, and Saunders, Hilary St. George. Royal Air Force, 1939-1945. Vol. II. London: HMSO, 1954.

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This book was the official history of the Canadian Air Force and covered sections on the Second World War.

Roscoe, Theodore. United States Destroyer Operations in World War II. Annapolis, Maryland: United States Naval Institute, 1953.
The primary emphasis was on Pacific operations but it contained some valuable information on the Atlantic Theater.

Roskill, S. W. War at Sea. 3 vols. London: HMSO, 1954-1960.
This was perhaps the most useful and complete work on naval operations in the Atlantic.

Rowland, Buford and Boyd, William. U. S. Navy Bureau of Ordance in World War II. Washington, D. C.: U. S. Government Printing Office, 1953.
This book was of some value for understanding the development of weapons but was not relied on too heavily for this paper.

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This book was a most useful and interesting book on the development of British torpedo planes and the role which they played in naval warfare during the last war.

Doenitz, Karl. The Years and Twenty Days. Trans. R. H. Stevens. London: Weidenfeld and Nicolson, Ltd., 1959.
This work by the leader of the German submarine arm was most illuminating on the method and tactics of operations with submarines against a maritime power.

Embry, Basil Mission Completed. London: Landsborough Publications Inc., 1958.
This work gave insight into the difficulties of operating anti-shipping strikes around the British Isles.

Hinsley, F. H. Command of the Sea: The Naval Side of British History from 1918 to the End of the Second World War. London: Christophers, 1950.
While this work did include comments on naval policy during the period between the wars it was mostly a study of the events of the Second World War.

James, William Milburne. The British Navies in the Second World War. London: Longmans, Green and Co., 1946.
This was another study by a high ranking naval officer of the events concerning the British Navy during the last war.

Joubert de la Ferte, Philip. Birds and Fishes: The Story of the Coastal Command. London: Hutchinson and Son Ltd., 1960.
This work by one of the commanders of Coastal Command gave an accurate description of the purpose and difficulties of this part of the R.A.F.

Macintyre, Donald. U-Boat Killer. London: Weidenfeld and Nicolson, 1956.
This book studies the methods of destroying German submarines through the eyes of an escort commander.

Pugsley, A. F. and Macintyre, Donald. Destroyer Man. London: Weidenfeld and Nicolson, 1957.
This work described, through the eyes of a commander, destroyers in nearly all the various types of actions available to them.

Raeder, Erich. My Life. Trans. Henry W. Drexel. Annapolis, Maryland: United States Naval Institute, 1960.
This work by the head of the German Navy practically from the Treaty of Versailles to 1943 showed some serious faults in understanding when dealing with political matters. These faults tended to be outright cover ups and lended a bad feeling to the reader of the book. Otherwise it was quite valuable because it showed how the naval leaders felt and what type war they expected.

Rayner, D. A. and Roskill, S. W. (ed.). Escort: The Battle of the Atlantic. London: William Kimber, 1955.
This work by a captain of an anti-submarine vessel and the leading British author of Second World War naval history produced a comprehensive study of the tactics and difficulties of anti-submarine warfare with the emphasis on convoy protection not hunter-killer groups.

Roskill, S. W. H.M.S. Warspite. London: Collins, 1957.
This was an interesting story of the famous old battleship which saw duty in two world wars but showed little about the best strategical method of employing battleships.

Ruge, Frederich. Der Seekreig. Trans. M. G. Saunders. Annapolis, Maryland: United States Naval Institute, 1957.
This work was the semi-official history of German naval operations during the last war but the major interest was mines which during the war were his specialty.

Scott, Peter. The Battle of the Narrow Seas. London: Country Life Ltd., 1945.
This was a study of motor boats by a former commander and while they were not particularly important in oceanic waters they exerted a great influence in the shallow waters surrounding England.

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Alden, John D. Flush Decks and Four Pipes. Annapolis, Maryland: United States Naval Institute, 1956.
This was a fair study on the development of American destroyers during the period between the wars. It showed the use and mis-use of American World War I destroyers.

Brickhill, Paul. The Dam Busters. New York: Ballantine Books, 1951.
This book described the development of the super heavy bombs to destroy not only reinforced structures but also the Tirpitz.

Brodie, Bernard. A Guide to Naval Strategy. New York: Frederick A. Praeger, 1965.
This copy which was supposed to be a new edition suffers from a lack of revising. It was only a new revision in that Brodie had added new chapters but had not rewritten the chapters which were part of the original edition. Also, it included whole sections lifted from his more important work, Sea Power in the Machine Age.

Brodie, Bernard. Sea Power in the Machine Age. Princeton, New Jersey: Princeton University Press, 1943.
This work was one of the more important studies on the impact of changing technology on the development and use of naval weapons.

Brou, Will-Charles. Combat Beneath the Sea. Trans. Edward Fitzgerald. New York: Thomas Y. Crowell Comp., 1947.
This work tended to deal with small units seccess and failed to pay enough attention either to the failures or the training of such units. Also, it gave no indication of the value of this method of attack in causing strategic dislocations.

Bywater, Hoctor C. A Scarchlight on the Navy. London: Constable and Co., Inc., 1935.
While this work was primarily directed to tho discussions of the naval limitation treaties it gave a good indication of tho thoughts of one military writer about the future of naval warfare.

Cowio, J. S. Mines, Minelayers and Minclaying. London: Oxford University Press, 1949.
This was one of the few books which described tho method of employing different types of mines. A very comprehensivo work on the effect of mines in two world wars and their countermeasures.

Cranwell, John Phillips. The Destiny of Sea Power and Its Influence on Land Power and Air Power. New York: W. W. Norton and Co., Inc., 1941.
This author has noticed some of the effects of changing weapons that had become obvious by 1941. In some instances he tended to give air power the ability to do things which it could not do and ignored its role in other military actions.

Creswell, John. Sea Warfare, 1939-45. London: Longmans, Groen and Co., 1950.
This was chronology of events during the naval part of the Second World War. It had little interpretation.

Divine. A. D. The Merchant Navy Fights: Tramps Against U-Boats. London: John Murray, 1940.
This work was mostly an attempt to boost the moral of the British seamen. While it included a numbor of appendixes showing that some merchant ships supposedly sank a few attacking U-Boats, the Admiralty's listing after the war gave no evidence of such sinkings.

Earle, Edward Mead. Makers of Modern Strategy: Military Thought From Machiavelli to Hitler. Princoton: Princeton University Press, 1943.
This work was used mostly for the articles on Mahan and the Jeune Ecole. Some of the other articles in this collection edited by Earle showed a serious misunderstanding of military writer's thought. One particular article was the article about Liddel Hart.

Grant, Robert M. U-Boats Destroyed: The Effect of Anti-Submarine Warfare, 1914-1918. London: Putnam and Company, 1964.
This work by a theologian studied the methods employed against submarines during the First World War and was used as a comparative measure for the Socond World War.

Green, William. Famous Bombers of the Socond World War. Garden City, New York: Doubleday and Company, Inc., 1960.
Basically a set of specifications on the more numerous bombers used during the last European war; it included short notes on the history of the aircraft but these were not its primary value.

Groner, Erich. Dio Schiffe Der Deutschen Kreigsmarine und Luftwaffe, 1939-1949. Munchen: J. F. Lehmans Verlag, 1954.
Tho main value of this work was that it gave the cost of the German ships and design plans for thom.

Grosvenor, Melville Bell (ed.). National Geographic Atlas of the World. Washington, D. C.: National Geographic Society, 1963.
For the sake of consistency this atlas has been used exclusively throughout this paper for determining the depth of water.

Hampshire, A. Cecil. Lilliput Fleet: The Story of the Royal Naval Patrol Service. London: William Kimber, 1957.
This was the story of the trawlers which were pressed into service because of the need to combat U-boats in the shallow waters around England.

Hart, Sydney. Submarine Upholder. London: Oldburne Books Co., Ltd., 1960.
This was the story of one of the most successful British submarines in the Mediterranean. While it was basically a chronology of events for the Upholder it did give some insight to the difficulties of submarine operations in the shallow waters of the Mediterranean.

Higham, Robin. Armed Forces in Peacetime: Britain, 1918-1940, A Case Study. Hamden, Connecticut: Archon Books, 1962.
This work traced the developments or lack of them in British military preparation for the next war. It covered a number of topics from psychology to monetary policy.

Higham, Robin. The Military Intellectuals in Britain, 1918-1939. New Brunswick, New Jersey: Rutgers University Press, 1966.
This work dealt with the military writers in England during the period between the wars. While its primary emphasis was on fields other than naval it did include some comments on naval writers.

Kelly, Robin A. and Grandville, Wilfred. Inshore Heroes: The Story of H. M. Motor Launches in Two World Wars. London: W. H. Allen, 1961.
This book pointed out the value of the small ships for special operations and escort duties.

Kemp, P. K. Fleet Air Arm. London: Herbert Jenkins, 1954.
This work by the head of the Admiralty Historical Office described the actions of the Royal Navy's aircraft.

Kemp, P. K. Key to Victory: The Triumph of British Sea Power in World War II. Boston: Little, Brown and Company, 1957.
In this book Kemp attributed the Allied victory over the Axis powers to the Allies' ability to control the sea.

Kemp, P. K. Victory at Sea, 1939-45. London: Frederick Muller, Ltd., 1957.
This work was primarily another source which described the naval events of World War II.

Kirk, John and Young, Robert. Great Weapons of World War II. New York: Walker and Company, 1961.
This book was basically a description of some of the more well known weapons used by both sides during World War II.

Korotkin, I. M. Battle Damage to Surface Ships During World War II. Trans. U. S. Joint Publications Research Service for the David Taylor Model Basin. Alexandria, Virginia: Defense Documentation Center for Scientific and Technical Information, 1964.

This book was extremely valuable because it described in detail the damage suffered by various types of surface warships during World War II. It was the only comprehensive study of damage to surface ships found. It was interesting to note that a Soviet author was the first to do such a study.

Kuenne, Robert E. The Attack Submarine: A Study in Strategy. New Haven: Yale University Press, 1965.

This was one of the most worthwhile books concerning the submarine operations of the last war. He has described submarine operations with an analogy similar to a flow analysis. This analogy was a very effective method of dealing with this particular weapon and could be applied to other types of naval weapons.

Landsborough, Gordon. Tobruk Commando. New York: Avon Publications Inc., 1958.

This has been included because it describes the loss of an anti-aircraft cruiser because of aircraft.

Lewis, David D. The Fight for the Sea: The Past, Present and Future of Submarine Warfare in the Atlantic. New York: Collier Books, 1961.

This was one of the better descriptions of the operations of submarines in the Atlantic during the last war but there was no central feature of the book such as Kuenne's.

Lott, Arnold S. Most Dangerous Sea. Annapolis, Maryland: United States Naval Institute, 1959.

This was the American interpretation of the use of mines during the Second World War. While most of it deals with the use of mines in the Pacific and off Korea it did have some good descriptions of the fear of using defensive minefields off the Eastern Seaboard of the United States.

Macintyre, Donald. The Battle For The Mediterranean. London: B. T. Batsford, Ltd., 1964.

This was a chronology of events in the Mediterranean during the Second World War.

Macintyre, Donald. The Thunder of Guns: A Century of Battleships. New York: W. W. Norton and Company, Inc., 1959.

This book by Macintyre traced the development of battleships and various operations dealing with them but he has not attempted to describe either their rise or their decline as the paramont weapon of naval warfare.

Manning, T. D. The British Destroyer. London: Putnam and Co., Ltd., 1961.

This was a short history of the development of the British destroyers and comments on their actions during two world wars.

McMurtie, Francis (ed.). Jane's Fighting Ships, 1941. New York: Macmillan Comp., 1942.
A number of different years in which Jane's were published have been used but throughout, this has been the primary one.

March, Edgar J. British Destroyers: A History of Development, 1892-1953. London: Seely Service and Co., Ltd., 1966.
This was a companion volume to the more famous British Battleships. It traced the design and construction of British destroyers through the period described in the title. It included numerous drawings of great detail, comments on the reasons behind the different designs of destroyers, and short notes on the history of certain destroyers.

Moore, John. The Fleet Air Arm: A Short Account of Its History and Achievements. London: Chapman and Hall, 1943.
While this book was another study in the development of the air force to go with the navy, Moore spent little time dealing with the controversy between the Royal Air Force and the Royal Navy over who was going to control aircraft which operated over the sea.

O'Connor, Raymond G. Perilous Equilibrium: The United States and the London Naval Conference of 1930. Lawrence, Kansas: University of Kansas Press, 1962.
This book not only explained the controversies which developed at the London Naval Conference but also explained the reason why each country felt that certain demands had to be met in order for their security to be insured.

Parks, Oscar. British Battleships: "Warrior" to "Vanguard," A History of Design, Construction and Armaments. London: Seely Service and Co., 1966.
This was a definitive study of the construction of British battleships. It covers a little over a hundred years and was well illustrated with design drawings and reasons for the special features and changes on each design.

Peck, Taylor. Round Shot to Rockets: A History of the Washington Navy Yard and the U. S. Naval Gun Factory. Annopolis, Maryland: United States Naval Institute, 1949.
This book gave some descriptions of the artillery employed on American warships and the reasons why this type of gun was chosen over other types.

Phillips, C. E. Lucas. The Greatest Raid of All. London: William Heinemann, Ltd., 1958.
This was the story of the commando raid on the Normandie Dock at St. Nazaire.

Pratt, Fletcher Harrison. Sea Power in To-Day's War. New York: Hilton Books, Inc., 1939.
This book was a most remarkable compendium of the errors in naval thinking during the period between the wars.

Robertson, Terence. Walker, R. N.: The Story of Captain Frederic John Walker, C. B., C. B. O. and-Three Bars, R. N. London: Evans Brothers Ltd., 1956.
This was the story of one of the most famous and successful of the commanders of escort vessels. Since his primary interest was hunter-killer groups good insight into this tactical method of destroying submarines was gained.

Roskill, S. W. A Merchant Fleet in War. London: Collins, 1963.
This story dealt with the Alfred Holt merchant fleet during the Second World War. While an interesting story there was little that could be gained from such studies unless one was praticularly interested in that particular company.

Roskill, S. W. The Strategy of Sea Power: Its Developments and Application. London: Collins, 1962.
This book was based on the Lees-Knowles lectures which Roskill delivered. In this book he traced the developments of British sea power up to the end of the Second World War.

Riesenberg, Felix. Sea War: The Story of the U. S. Merchant Marine In World War II. New York: Rinehart and Comp. Inc., 1956.
This was an attempt to explain the difficulties and hardships of American merchant seamen. The author has succeeded but the book has little historical value.

Schofield, William G. Destroyers--60 Years. New York: Bonanza Books, 1962.
This was generally too much propaganda and too little history.

Schofield, William G. Eastward the Convoys. New York: Rand-McNally and Co. 1965.
This was an attempt to describe the convoy traffic to England. While it had some interesting stories generally it did not describe the operations and perils of convoys that supplied the Allied armies in Europe.

Schurman, D. M. The Education of a Navy: The Development of British Naval Strategic Thought, 1867-1914. Chicago: University of Chicago Press, 1965.
While this book ended in a period of time which was before this paper begins it gave interesting insights into the philosophy and its development of British naval thought. It did include a section on Admiral Sir Herbert Richmond, who was one of the leading naval intellectuals of the period between the wars.

Seth, Ronald. The Fiercest Battle: The Story of North Atlantic Convoy ONS 5 22 April--7 May, 1943. New York: W. W. Norton and Comp., 1961.
This was probably the stereotype of both a "wolf-pack" attack on a convoy and the stereotype of the successful defensive measures performed by the escorts. While generally tactical studies of battles have little value for historians this study, since it was typical of the Battle of the Atlantic, was of great value.

Tuleja, Thaddeaus V. Twilight of the Sea Gods. New York: W. W. Norton and Co. Inc., 1958.
This was the story for popular consumption of the destruction of the German Navy.

Turner, John Frayn. Service Most Silent: The Navy's Fight Against Enemy Mines. London: George C. Harrap and Co., Ltd., 1955.
This was an interesting and valuable story of the methods of taking apart German mines and devising countermeasures.

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The subject of this book was well covered in the title. It was an interesting and well written story, but Woodward has not connected it to an understanding of a strategic problem of battleships.

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Cooke, H. D. "The Atlantic Convoys," USNIP, Vol. 76, no. 8, (August, 1950), p. 863-869.

Dewar, C. "Disarmament and Naval Polity," Brassey's (1935), p. 61-73.

Dougherty, Leonard. "The Effect of Depth Charges on Submarines," USNIP, Vol. 61, no. 3, (March, 1935), p. 353-7.
This attempts to explain the difficulties with depth charges when attacking submarines in World War I.

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In this article Friedman argued for the building of anti-aircraft cruisers and seemed to feel that at least historically they were the method to protect the battlefleet from aircraft.

Gilbert, Nigel, John. "British Submarine Operations in World War II," USNIP, Vol. 89, no. 3. (March, 1963), p. 1047-1053.

Grant, Robert M. "Aircraft Against U-Boats," USNIP, Vol. 65, no. 6, (June, 1939), p. 824-828.

Grant, Robert M. "The Use of Mines Against Submarines," USNIP, Vol. 64, no. 9, (September, 1938), p. 1275-1279.
This article explains the method which caused mines during the greater part of World War I to be the most deadly form of anti-submarine warfare.

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Robinson, Walton L. "Naval Actions, 1939-41," USNIP, Vol. 68, no. 8, (August 1942), p. 1125-33.

Roskill, S. W. "Capros not Convoy: Counterattack and Destroy," USNIP, Vol. 87, no. 10, (October, 1956), p. 1047-1053.
This article was written while Roskill was still writing the first two volumes of his history of the naval war. These volumes covered the earlier period when hunter-killer groups were not an effective method of destroying submarines. It would be interesting to know if he changed his opinion after writing the later volumes. The word "Capros" was coined by Roskill and was derived from the first letters of Counter Attack Protection and Routing of Shipping.

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THE BEST WAY TO DESTROY A SHIP
THE EVIDENCE OF EUROPEAN NAVAL OPERATIONS IN WORLD WAR II

by

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The purpose of this paper has been to analyse particular aspects of naval operations in the Atlantic Theater during the Second World War. An attempt has been made not only to describe the method of employing naval weapons but also to judge their effectiveness in a statistical manner. In certain cases such descriptions have been either difficult or impossible because of insufficient information.

There are a number of historical studies which describe battles and campaigns, but few attempts have been made to analyse the effectiveness of the weapons employed. Prior to World War II a number of speculations were made about the effectiveness of weapons in the next war. Some of these proved true and some false, but in nearly all cases little or no study was attempted to describe the effectiveness of weapons in the First World War. Because of a lack of understanding about the effectiveness of weapons in World War I a number of mistakes were made about the most useful weapon. Richmond's faith in the cruiser appeared to be one area where such a study would have been useful.

Both sides has certain misconceptions about the course of the next war. England expected the support of France to continue throughout the war. The sudden failure of the French armies cast an entirely different light on the naval war which England carried on. Germany, on the other hand, felt that the war would be short and, consequently, they did not need to concern themselves with a naval force. The events of the Second World War showed both of these views to be wrong. Further it seemed that Germany could afford to take chances on new developments in weapons because they were no dependent on the sea for survival. England, on the other hand, could not survive unless she controlled the sea and was therefore more conservative in her naval policies.

This paper attempted to resolve a number of problems in each major catagory of weapons throughout the war. They have been analysed by chapters according to type of weapon or delivery system: mines, aircraft, battleships, other surface ships, and finally submarines. By using a statistical method, aircraft were found to be the most effective weapon of naval warfare. While this agreed with a number of predictions made by airpower enthusiasts it had certain flaws in it. They predicted that their weapons would be useful for destroying capital ships. While aircraft did destroy a number of battleships in the Atlantic, this destruction was not accomplished as easily as they had predicted. Aircraft achieved their greatest success in a field which was ignored during the period between the wars. Airplanes were found to be an excellent weapon for the destruction of submarines and achieved some success in attacks on ports and shipping.

The next most effective weapons in order of declining importance were: submarines, mines, destroyers, battleships, and cruisers. Submarines, mines and destroyers were ignored by naval intellectuals during the period between the wars. Battleships received a great deal of attention because they were no longer considered useful weapons. This idea was caused partially by the stalemate at Jutland. Cruisers, which were Richmond's favorite naval weapon, proved to be the least effective of all.

The proper value of weapons could not be reached until studies dealing with the operation of weapons had been completed. This paper which it reached a number of conclusions about the effectiveness of weapons is basically a experiment in this type of analysis. If this paper loses its value it does so because of technological or political change, but this does not remove its value as a method of historical analysis.